Engineering Library

With BRITISH INDUSTRIES FAIR SUPPLEMENT.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND. LONDON. W.C. 2.

VOL. CXLIX.—No. 3866] LONDON: FRIDAY EVENING, FEBRUARY 14, 1930 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

MAR 3 1930

PUBLIC NOTICES

Maintenance Engineer REQUIRED for Electric Lifts, Cranes, Heating Boilers, Saw Mill, Automatic Telephones, Lighting, Running and Assorted Repairs, in large waterside building. Salary £250-£7 10s.-£325, plus bonus on Civil Service Scale, making commencing salary £361 per annum. Appointment is non-pensionable and terminable at one month's notice on either side. Qualified engineer with mechanical and electrical experience, aged 35/40, desired.—Applications, by letter only, with copies, not originals, of references, to the DIRECTOR-GENERAL, India Store Department, Belvedere-road, Lambeth, S.E. 1. 4428

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/1975.—ASSISTANT ARCHITECT REQUIRED by the GOVERNMENT of NIGERIA for two tours of 12 to 18 months' service and possible extension. Salary £480 a year for the first three years, then £510, rising to £720 a year by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, 25 to 35 years of age, should be A.R.I.B.A. or hold some equivalent Diploma. Should have had architectural experience on a municipal, county or similar office.

M/1968.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of TANGANYIKA TERRITORY for the Public Works Department for a tour of 20 to 30 months' service, with possible extension. Salary £480, rising to £600 a year by annual increments of £20 and thence rising to £720 a year by annual increments of £30. Free quarters and passages and outfit allowance of £30 on first appointment. Candidates, aged 25 to 30, unmarried, must have passed Sections "A" and "B" of the A.M.I.C.E. examination or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Must be capable of levelling, surveying and measuring up work, and, in addition, to preparing neat drawings for the design of bridges, &c. Must have had at least three years' experience under a qualified civil engineer on the construction of railway works, drainage works, water supply or other public works.

M/1990.—ASSISTANT ENGINEERS REQUIRED for the Public Works Department of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtain such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a civil engineer of good standing, and have passed Sections "A" and "B" of the examinations for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 4454

THE
LONDON ASSOCIATION OF FOREMEN ENGINEERS
ESTABLISHED 1852.
FOREMEN, MANAGERS and EMPLOYERS connected with the Engineering Industry.

Seventy-seventh Anniversary Festival

SATURDAY, MARCH 1st, 1930.

CHAIRMAN:
JOHN WEIR, ESQ., M.I.M.E.

Tickets 15/- *each.*

Apply on or before February 19th, to SECRETARY: W. ROBINSON, 132a, ADELAIDE ROAD, BROCKLEY, S.E. 4. P 6659

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to 2.30 p.m. on Wednesday, 5th March, TENDERS for the SUPPLY of :—

METALS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices, The White Mansion, 91, Petty France, Westminster, S.W. 1.
12th February, 1930. 4447

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

British Industries Fair at Birmingham. (Special Eight-page Supplement).
THE ENGINEER, 14 - 2 - 30.

Issy-les-Moulineaux Power Station: High Pressure Extensions. (P. 178)
THE ENGINEER, 14 - 2 - 30.

Humanising Industry. (P. 189)
THE ENGINEER, 14 - 2 - 30.

Atmospheric Pollution in 1928-29. (P. 180)
(J. B. C. KERSHAW.) THE ENGINEER, 14 - 2 - 30.

The World Engineering Congress in Japan No. IX. (P. 190)
THE ENGINEER, 14 - 2 - 30.

Scientific Research on Railways. (P. 190)
THE ENGINEER, 14 - 2 - 30.

The First "Wood" Steam Generator No. III. (P. 194)
(E. W. SMYTH.) THE ENGINEER, 14 - 2 - 30.

Projects for Tunnelling the Straits of Gibraltar. (P. 184)
THE ENGINEER, 14 - 2 - 30.

Re-boring Machine for Motor Car Cylinders. (P. 192)
THE ENGINEER, 14 - 2 - 30.

INDEX TO ADVERTISEMENTS, PAGE 85.

PUBLIC NOTICES

University of Birmingham. APPOINTMENT OF ASSISTANT LECTURER IN DEPARTMENT OF METALLURGY.

APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER in METALLURGY. Preference will be given to candidates with practical experience in the Metallurgy of Steel. Stipend £300 per annum. Duties to begin not later than 29th April, 1930. Four copies of application, with testimonials or references, must be sent on or before 3rd March to the undersigned, from whom further particulars may be obtained.

C. G. BURTON,
Secretary.

The University, Edmund-street, Birmingham, February, 1930. 4451

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. SPARE PARTS for TRAIN LIGHTING CELLS (Miscellaneous);
2. LEATHER GOODS—CASH BAGS and HIDES; and
3. INDIA-RUBBER GOODS—PIPES, SHEETS, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked: "Tender for Spare Parts for Train Lighting Cells (Miscellaneous)," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 28th February, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the Specification No. 1 and of 5s. for each copy of the Specifications Nos. 2 and 3.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1.
12th February, 1930. 4453

PUBLIC NOTICES

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for :—

2000 AXLE-BOXES for CARRIAGES and WAGONS (Cast Steel or Malleable Cast Iron) Broad Gauge.

Tenders are due in on Tuesday, 4th March, 1930, by 2 p.m.

Tender form obtainable at address below; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road, Westminster, S.W. 1. 4435

TWO GENERATING SETS FOR SALE.

ONE BELLISS and MORCOM TOTALLY ENCLOSED STEAM ENGINE, triple-expansion, cross type, self-lubricating, 2200 H.P., 200 r.p.m., 165 lb. steam pressure

Direct coupled with

ONE THREE-PHASE GENERATOR, 1400 kW, 50 cycles, 5000/5500 volts, 206 amps., with exciter, surface condenser, air pump and circulating water pump.

This unit has been completely overhauled and is in perfect working order.

ONE PARSONS STEAM TURBINE (Richardsons, Westgarth and Co.), 2200 H.P., 1500 r.p.m., 165 lb. steam pressure.

Direct coupled with

ONE THREE-PHASE GENERATOR, 1500 kW, 50 cycles, 5000/5500 volts, 157/216 amps, with exciter, with condenser contraflow pattern, air pump and circulating water pump.

This unit is in excellent condition.

Further particulars may be obtained from the SECRETARY,
The Irish Free State Electricity Supply Board, Upper Mount-street, Dublin. 4439

PUBLIC NOTICES

Belfast Harbour. TO DREDGING CONTRACTORS.

The Belfast Harbour Commissioners are prepared to receive TENDERS from competent Dredging Contractors for the WORK of DREDGING, CONVEYING and DEPOSITING certain MATERIALS within and in the neighbourhood of the Port and Harbour of Belfast, from a New Dock and Approach Channel, &c.

Specification, form of Tender, and any further information may be obtained from the Harbour Engineer, Mr. T. S. Gilbert, M. Inst. C.E.

Sealed Tenders, on the special form provided for the purpose, should be addressed to the undersigned, endorsed "Tender for Dredging, Conveying and Depositing Dredged Materials," and delivered not later than Monday, the 3rd March, 1930.

The Commissioners do not bind themselves to accept the lowest or any Tender.

M. J. WATKINS,
General Manager and Secretary.

Harbour Office, Belfast, 5th February, 1930. 4412

The Bengal and North-Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

	No.
STEEL AXLES (Loco., Carr. and Wagon)	354
" BUFFERS (Carriage and Wagon)	700
" TYRES (Loco. Carr. and Wagon)	476

as per specifications to be seen at the Company's Offices.

Tenders, addressed to the undersigned and marked "Tender for Steel Axles," or as the case may be, with name of firm tendering, to be lodged not later than Noon on Tuesday, the 4th day of March, 1930.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
W. R. IZAT,
Managing Director.

237, Gresham House, Old Broad-street, London, E.C. 2. 12/2/1930. 4446

The Portsmouth Gas Company invite APPLICATIONS for the POSITION of ASSISTANT ENGINEER.

Commencing salary £700 per annum.

Applicants must have had a sound engineering training and be fully experienced with the design and construction of all plant required by the Company's operations from Coal Unloading Docks to the Gasholders. A knowledge of distribution, including the design of plant necessary for the supply of gas to outlying districts is also essential.

The successful candidate will participate in the contributory superannuation benefit and will be required to pass a medical examination.

Applications, giving age, full particulars of training and experience, should be accompanied with two recent testimonials and received by the Chairman of the Company, in an envelope endorsed "Assistant Engineer," not later than 27th February instant.

T. CARMICHAEL,
Engineer.

The Portsmouth Gas Company, Chief Offices, The Square, Portsmouth. 4423

SITUATIONS OPEN
COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ASSISTANT MANAGING DIRECTOR WANTED for Australian branch houses of a large and old-established firm of British Engineers. Sound commercial and engineering knowledge essential; also ability to control staff, act on own initiative, with capacity to ultimately qualify for the chief executive position.—Applicants should send full details of training, experience and salary required. Replies will be treated in the strictest confidence.—Address 4450, The Engineer Office. 4450 A

ASSISTANT WORKS MANAGER REQUIRED by Manufacturers of Wire Ropes, Wire, &c., employing over 1000 hands. Duties chiefly connected with organisation, planning, time and labour-saving studies.

Experience in Wire Trade desirable, but not absolutely essential.

YOUNG ENGINEER, with Technical qualifications and actual Works Management experience; knowledge of Estimating, Operation Planning and Rate Fixing preferred.—Address fully, stating age, experience, salary desired, &c., to 4417, The Engineer Office. 4417 A

EXPERT RATE FIXER WANTED. Must be thoroughly experienced in Steam Turbine and Electrical Generator Manufacture.—Address, stating age, experience, and whether used to electrical windings also, and salary required, 4384, The Engineer Office. 4384 A

MANUFACTURERS of Waterworks Fittings REQUIRE REPRESENTATIVE for Lancashire, Yorkshire and Midlands. Must be trained Engineer and have experience of calling upon Waterworks Engineers. Write, giving particulars of age and experience. Applications will be treated in the strictest confidence. —Address, 4414, The Engineer Office. 4414 A

SITUATIONS OPEN (continued) Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 86.
PARTNERSHIPS, Page 2.
MACHINERY, &c., WANTED, Page 86.
EDUCATIONAL, Page 4.
MISCELLANEOUS, Page 4.
PATENTS, Page 4.
BUSINESSES and PREMISES (For Sale, etc.). Page 86.
AGENCIES, Page 4.
FOR SALE, Pages 4 and 86.
WORK WANTED, Page 86.
FOR HIRE, Page 86.

For Advertisement Rates see Leader Page.

SITUATIONS OPEN (continued)

METALLURGICAL CHEMIST, with over 30 Years of Steel Works experience, is DESIROUS of ESTABLISHING a CONNECTION in a Consultative capacity with a few firms of Steel (&c.) users.—Address, 4422, The Engineer Office. 4422 A

METALLURGIST REQUIRED IMMEDIATELY. Must be accustomed to Engineering Machine Shop Practice, also a knowledge of the equirements of Tool Steels and Machine Shop Materials, including Press Steels, Forgings and Cast Iron.—Apply, stating age and give full particulars of qualifications, to HENRY FORD and SON, Ltd., Cork, Ireland. 4419 A

PRODUCTION ENGINEER.—WANTED, ENGINEER, with first-class experience and up-to-date knowledge Heavy Engineering Production, to report on present methods in large shops dealing with great variety of work with view to improvements and economies in manufacture.—Write, Box 805, Sells Advertising Offices, Fleet-street, E.C. 4. 4448 A

RATE-FIXER, Experienced, REQUIRED for a Well-known works in the Midlands. This position offers good prospects to a tactful, energetic man with a sound knowledge of Modern Machine Shop Practice and Tool Design.—Write, in confidence, giving age, experience and salary required, to Box 787, Sell's Advertising Offices, Fleet-street, E.C. 4. 4425 A

RATE-FIXER WANTED for Steel Furniture Factory near London. Must have had a thorough workshop training and be capable of Fixing Rates from Blueprints. Knowledge of Sheet Metal Work essential.—Address, giving age, full details of experience and salary required, to 4434, The Engineer Office. 4434 A

YOUNG ENGINEER of Good Address and Personality REQUIRED for Chile. Must be unmarried. Experienced in shops, drawing-office, and estimating departments. Preference will be given to applicant with knowledge of Spanish. Five-year contract. Passages supplied each way. Commencing salary £300 per annum, advancing £25 per annum.—Write, stating age, nationality, where educated, full details of experience, &c., to Z.T. 54, c/o Deacon's, Fenchurch-avenue, E.C. 3. 4456 A

WANTED, First-class DRAUGHTSMEN, Experienced in the Design of High-class Rolling Mill Plant and General Engineering; also JUNIORS conversant with the above Plant.—Address, stating experience, salary required, &c., to 4433, The Engineer Office. 4433 A

WANTED, 2 or 3 DRAUGHTSMEN with some experience on Machine Tool Work (experience in Jig and Tool Work is not sufficient).—Address, stating age, experience and salary required, 4300, The Engineer Office. 4300 A

DESIGNERS.—TWO Good-class MACHINE TOOL and PLANT DESIGNERS, Engineer-draughtsman experienced on General Factory Plant with some Electrical Knowledge should write fully in confidence, giving experience, age, salary. Regular post, London.—Address, 4418, The Engineer Office. 4418 A

CHIEF DRAUGHTSMAN WANTED; 15/20 Draughtsmen; Tanks, Pressure Vessels and General Engineering. Must have had Workshop experience. Previous experience of Tank Work not essential. First-class practical knowledge of Design in Structural Work and general Mechanical Engineering essential. State age, experience and salary required.—ROBERT JENKINS and CO., Ltd., Rotherham. 4436 A

DRAUGHTSMAN.—ELECTRICAL ENGINEERS in the Midlands have VACANCY for experienced SENIOR DRAUGHTSMAN possessing sound knowledge of Mechanical Design of large capacity High Voltage Transformers.—Address, giving particulars of experience, age and salary required, 4304, The Engineer Office. 4304 A

DRAUGHTSMAN, JUNIOR, with Experience of Mechanical Detailing and Copper Work. Age about 23, N. London area.—Address, giving full particulars and salary required, 4440, The Engineer Office. 4440 A

DRAUGHTSMAN REQUIRED. Good Opening for keen young man. Air Compressor experience, especially Rotary, desirable.—State age, experience and salary required, REAVELL and CO., Ltd., Ipswich. 4429 A

DRAUGHTSMEN, SENIOR, Having Sound Experience of Electric Control and Contactor Gear.—Applications, stating age, experience and salary required, with copies of references, 4415, The Engineer Office. 4415 A

JIG and TOOL DESIGNER for Small Mechanical Detail. Mass production.—Address, stating age, experience and salary required, 4416, The Engineer Office. 4416 A

DRAUGHTSMAN WANTED, Capable of Designing. Knowledge of Linoleum Plant an advantage.—Address, stating age, experience and salary required, P6680, The Engineer Office. P6680 A

DRAUGHTSMEN WANTED for Switchgear Design. Experience with Compound-filled Gear preferred. Good opportunities.—Apply, stating age, experience and salary required, to the ENGLISH ELECTRIC COMPANY, Ltd., Stafford. 4315 A

DRAUGHTSMAN WANTED, One with Knowledge of Marine Engine Room Auxiliaries, especially good knowledge of Evaporators and Plant appertaining to same.—Address, stating age, experience, wages required, &c., 4430, The Engineer Office. 4430 A

DRAUGHTSMEN WANTED for Public Works Contractors' Office in the East. Experience in Dock Work Excavation and Contractors' Plant. Four years' agreement.—Address, giving particulars, experience, age and salary required. 4424, The Engineer Office. 4424 A

EXPERIENCED DRAUGHTSMAN REQUIRED in the London Office of Contracting Engineers for Conveyor Work. State age, experience, and salary required.—Address, 4395, The Engineer Office. 4395 A

REQUIRED for Important British-owned Railway in Argentina,

STRUCTURAL STEELWORK DRAUGHTSMAN, with thorough theoretical knowledge of the Design of Railway and Highway Bridges and of Steel-framed Buildings.

TWO DRAUGHTSMEN with thorough knowledge of Calculation and Design of Bridge Abutments and Retaining Walls in Brick or Mass Concrete. Must have sound knowledge of Design of Armoured Concrete Railway Structures, and be capable of Preparing Working Drawings and Quantities.

Salary on three years' agreement, £450, rising to £550 p.a. Free passages.—Reply, stating age, if single or married, and full details of training and experience, with copies (only) of testimonials, to Box W. Y. A., c.o. Davies and Co., 95, Bishopsgate, London, E.C. 2. 4449 A

REQUIRED, SEVERAL DRAUGHTSMEN, Preferably experienced in Civil and Mechanical Engineering, and ONE TRACER.—Address, in confidence in the first place, giving full particulars, experience, age, salary, when at liberty, &c., 4421, The Engineer Office. 4421 A

THREE SMART MECHANICAL DRAUGHTSMEN REQUIRED in S.W. London with Brewing, Chemical, or Dairy experience an advantage. A permanent position is offered to quick and accurate men. Age 26 to 32.
Address, P6679, The Engineer Office. P6679 A

LONGMANS

STRAIN ENERGY METHODS OF STRESS ANALYSIS.
By A. J. SUTTON PIPPARD, M.B.E., D.Sc., M. Inst. C.E., M.I. Mech. E.
With Illustrations. 8vo. 14s. net.

CIVIL ENGINEERING SPECIFICATIONS AND QUANTITIES.
By G. S. COLEMAN, D.Sc. (Eng.), A.M. Inst. C.E., Assoc. M. Inst. Mun. & Cy.E., and G. M. FLOOD, B.Sc. (Eng.), A.M. Inst. M. & Cy. E., A.M.I. Struct. E.
With Diagrams. 8vo. 10s. 6d. net.

REINFORCED CONCRETE DESIGN.
By G. P. MANNING, B. Eng., Assoc. M. Inst. C.E.
With 208 Illustrations. 8vo. 21s. net.

STRUCTURAL ENGINEERING.
By JOSEPH HUSBAND, M. Inst. C.E., and WILLIAM HARBY.
Fourth Edition, Revised and Enlarged. With 393 Diagrams. 8vo. 16s. net.

THEORY OF STRUCTURES.
By ARTHUR MORLEY, D.Sc., M.I. Mech. E. With 324 Diagrams. 8vo. 12s. 6d. net.

STRENGTH OF MATERIALS.
By ARTHUR MORLEY, D.Sc., M.I.Mech.E. With 267 Diagrams and numerous Examples. Seventh Edition. 8vo. 12s. 6d. net.

MECHANICS APPLIED TO ENGINEERING.
By JOHN GOODMAN, Wh. Sch., M. Inst. C.E. Crown 8vo.
VOLUME I. Ninth Edition. With 741 Illustrations and numerous Examples. 14s. 6d. net.
VOLUME II. Chiefly worked Examples. With 198 Illustrations, 711 Examples and Notes. 16s. net.

MECHANICS FOR ENGINEERS.
A Text-book of Intermediate Standard. By ARTHUR MORLEY, D.Sc., M.I. Mech. E.
With 200 Diagrams and numerous Examples. Crown 8vo. 6s. 6d. net.

APPLIED MECHANICS.
Embracing Strength and Elasticity of Materials. Theory and Design of Structures, Theory of Machines and Hydraulics. A Text-book for Engineering Students.
By DAVID ALLAN LOW (Wh. Sch.), M.I. Mech. E.
With 850 Illustrations and 780 Exercises. 8vo. 12s. 6d. net.

ELEMENTARY APPLIED MECHANICS.
By ARTHUR MORLEY, D.Sc., M.I.Mech.E., and WILLIAM INCHLEY, B.Sc., A.M.I.Mech.E. With 285 Diagrams and numerous Examples. Crown 8vo. 5s. net.

MACHINE DESIGN, CONSTRUCTION AND DRAWING.
By HENRY J. SPOONER, C.E., M.I. Mech. E., A.M. Inst. C.E., etc.
With 126 Tables and over 1,600 Figures.
Sixth Edition, Revised and Enlarged. 8vo. 21s. net.

MECHANICS OF PARTICLES AND RIGID BODIES.
By JOHN PRESCOTT, M.A., D.Sc.
Second Edition. With Diagrams. 8vo. 14s. net.

APPLIED ELASTICITY.
By JOHN PRESCOTT, M.A., D.Sc.
With Diagrams. 8vo. 25s. net.

PRACTICAL GEOMETRY AND GRAPHICS.
By DAVID ALLAN LOW (Whit. Sch.), M.I. Mech. E.
With over 800 Illustrations and over 700 Exercises. 8vo. 9s. net.

HEAT ENGINES.
Embracing the Theory, Construction, and Performance of Steam Boilers, Reciprocating Steam Engines, Steam Turbines, and Internal Combustion Engines.
A Text-book for Engineering Students.
By DAVID ALLAN LOW (Whit. Sch.), M.I. Mech. E.
With 656 Illustrations and 315 Exercises. 8vo. 15s. net.

STEAM TURBINES.
By WILLIAM J. GOUDIE, D.Sc., M.I. Mech. E., Assoc. M. Inst. C.E.
Second Edition. Rewritten and Enlarged. With 329 Illustrations and numerous Examples. 8vo. 30s. net.

THE THEORY OF HEAT ENGINES.
By WILLIAM INCHLEY, B.Sc., A.M.I. Mech. E.
Third Edition. With 246 Diagrams. 8vo. 12s. 6d. net.

HEAT ENGINES.
By WILLIAM RIPPER, C.H., D.Eng. (Sheffield), D.Sc. Eng. (Bristol), M.I.C.E., M.I. Mech. E.
With 214 Illustrations, and an Appendix of Questions and Exercises. Crown 8vo. 4s.

LONGMANS, GREEN & CO., LTD., 39, Paternoster Row, London, E.C. 4.

SITUATIONS OPEN (continued)

MACHINE SHOP FOREMAN WANTED for Manufacture of Excavating Machinery by Large Engineering Firm in East Midlands. Applicants must possess Expert Practical Knowledge of Modern Machine Tools and Methods, with ability to get results. Must be experienced in Control of Men and Quantity Production of Interchangeable Parts. State age, full details of experience, salary required, and when at liberty. Replies will be treated in strictest confidence.—Address, 4420, The Engineer Office. 4420 A

WANTED, SHIFT DRIVER, for Diesel Engines in South of England. One with experience of M.A.N. Engines preferred.—Address, giving reference and wages required, P6681, The Engineer Office. P6681 A

PATTERN MAKERS (Engineers), Permanency.—Apply, PERCY J. SMITH, 2A, Wynyatt-street, London, E.C. 1. 4317 A

SITUATIONS WANTED

WANTED by A.M.I.C.E., A.M.I.M.E., F.P.W.I. (late Royal Engineers, G.W.), civil and mech. engineer, specialist permanent way bridge work, exceptional experience and testimonials, responsible POSITION on Railway or Mechanical Work, Europe or Colonies; linguist; invest capital.—Address, P6683, The Engineer Office. P6683 B

A M.I. MECH. E. and MECHANICAL PARTNER, with wide commercial experience, well known to the leading mechanical, electrical and motor engineering firms in the Midlands, are open to REPRESENT an established manufacturer on commission and expenses; no salary.—Write, Box C275, c/o 19-21, Corporation-street, Birmingham. P6685 B

ADVERTISING and SALES MANAGER, 36, fully qualified in all branches of publicity, sound commercial experience, first-class copy and ideas man. Available from March 1st. Qualified to take over and co-ordinate entire sales promotion and advertising campaign of large manufacturing house. Principals only.—Address, 4413, The Engineer Office. 4413 B

ADVERTISER, Fully Trained Technical and Practical engineer, having large connection in the Midlands, DESIRES POSITION as Engineer Representative.—Address, P6677, The Engineer Office. P6677 B

BUYER OF ASSISTANT (25) SEEKS PROGRESSIVE POSITION; 8 yrs.' experience gen. and elec. engineers and merchants; single, disengaged.—Address, P6693, The Engineer Office. P6693 B

ENGINEER and MANAGER DESIRES an Immediate RESPONSIBLE APPOINTMENT as Manager, Engineer, or Representative; good organiser, able to control large number of men. Commercial and technical experience. Excellent record; very keen.—Address, 4409, The Engineer Office. 4409 B

ENGINEER, A.M.I. Mech. E., Many Years' Experience design and manufacture process plant for chemical works, handling plant, factory layout and organisation, including male and female labour, problems in economical production, REQUIRES fresh APPOINTMENT in position of responsibility. Excellent references.—Address, P6689, The Engineer Office. P6689 B

ENGINEER of Ways of Communication. All-round experienced organiser, DESIRES POST in any part of the globe.
Knowledge: English, French, German, Portuguese, Russian, Polish.
If desired, full informations, Poland, Warsaw, Gornoslazkastr., N. 16 ap. 41, Dipl. Eng. A.W. P6688 B

ENGINEER (48), Well Educated, with Fluent German and Russian, wide practical and commercial experience in responsible positions, SEEKS suitable POSITION.—Address, P6669, The Engineer Office. P6669 B

ENGINEER, Well Educated (38), Last 3 Years manager and chief engineer large constructional undertaking, Australia, present engaged responsible post, S. America, experienced design, layout and installation hydro-electric power schemes, transmission lines, water schemes, pipe lines, mine haulage, aerial ropeways, crushing, grinding and metallurgical plants, ferro-concrete, also surveying, steam, I.C., mechanical transport, used controlling staff and labour force, highest references, SEEKS responsible POST, executive, with firm manufacturers or contractors, England or representative leading house. Would travel. Available summer, 1930. Moderate salary with prospects.—Address, P6687, The Engineer Office. P6687 B

MAINTENANCE ENGINEER or WORKS MANAGER, experienced with large steam installations, conveyors, transporters, steam excavators, locomotives and heavy plant; good references and record.—Address, P6694, The Engineer Office. P6694 B

MECHANICAL ENGINEER, A.M. Tech. I., Age 31, SEEKS RESPONSIBLE POSITION; can take full control any plant; taken full charge outside erection; well educated, make own drawings, calculations.—Address, P6696, The Engineer Office. P6696 B

POWER-HOUSE DRAUGHTSMAN, Experienced in boiler-house, turbine and condensing plant layouts, all classes of pipe arrangements, structural steel, reinforced concrete and marine work, DESIRES POSITION with scope for hard work.—Address, P6622, The Engineer Office. P6622 B

DESIGNER and DRAUGHTSMAN, Aged 31, REQUIRES CHANGE. Wide workshop experience and good theoretical knowledge. Experienced with research work on instruments and small mechanisms.—Address, P6690, The Engineer Office. P6690 B

DRAUGHTSMAN (25) SEEKS POSITION; 5 years D.O., 2 years' shops experience and 3 years' technical training, London district.—V. G., 79, Grove-lane, Stamford Hill, N. 16. P6691 B

JUNIOR DRAUGHTSMAN, Age 23, SEEKS CHANGE; 6 years' D.O. experience, high-speed steam engines. Good education.—Address, P6684, The Engineer Office. P6684 B

LADY TRACER REQUIRES POST, Structural and technical; 11 years' experience; neat and accurate worker.—Write, K. C., 11A, Hyde Park-mansions, N.W. 1. P6695 B

LEADING DRAUGHTSMAN, with Wide Experience in structural engineering, including loft and shop training, DESIRES CHANGE. Thoroughly reliable and first-class organiser.—Address, P6686, The Engineer Office. P6686 B

PARTNERSHIPS

TO MANUFACTURERS.—ENGINEERING WORK offered up to £75,000 per annum to Manufacture and Supply Electrical and Mechanical Components in return for £20,000 investment. Advertisers are well-established London concern, vending electro-mechanical units in world markets.—Address, 4458, The Engineer Office. 4458 C

YOUNG ENGINEER WANTED for Business Extensions; partnership for a suitable man; £500 investment.—Address full particulars of training to P6692, The Engineer Office. P6692 C

For continuation of Small Advertisements see page 4.

A Seven-Day Journal

The Electrical Research Association.

SPEAKING at the annual luncheon of the British Electrical and Allied Industries Research Association, held at the Savoy Hotel on Friday, February 7th, the new President of the Association, Mr. E. Garcke, said that there could be no doubt that the research work done by the Association, expressed only in terms of money, without dwelling on its other merits, was of very considerable value. The researches on lubricating oils had cost about £8500 in all, but the saving to the industry represented at least £100,000 per annum. The researches on buried cables had cost up to date about £18,500, but had saved the industry at least a quarter of a million pounds and had added something like four millions to the duration value of existing cables. Special research work of benefit only to a few firms should be carried out by those firms individually, whilst the work undertaken by the Association should be of a kind that would benefit a large number of firms or the industry as a whole. While the Association had made very encouraging progress in the direction of collecting funds, it was to be remembered that research could never end, and all beneficiaries who had been backward in giving support were still expected to augment the financial resources of the Association. At the present time the country was not suffering from lack of scientific research in most departments. The last report of the British Association mentioned about seventy research committees appointed to investigate problems in the various sciences, and there were many other organisations dealing with research. But whilst the country was not suffering from lack of scientific research in most departments it lacked directional use of the results of research. There were many unused ideas and potential improvements available. There was more to develop in a practical sense than could be tackled with the available capital and resources at command. When business was good and suggestions were made for the adoption of new methods and appliances there was an inclination to say "Why not leave well alone," whilst in times of adversity it was argued that it would be folly to spend capital on improvement.

H.M. Destroyer Anthony.

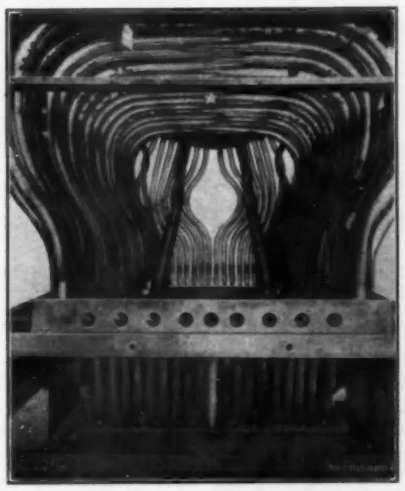
THE new torpedo-boat destroyer H.M.S. "Anthony," which has been built and engined by Scott's Shipbuilding and Engineering Company, Ltd., at Greenock, recently underwent successful Admiralty trials. She is one of the group of destroyers ordered under the 1927 building programme, and, like all the vessels of her class, has a length of 312ft., with a beam of 32ft. 3in., the mean draught being 8ft. 6in. on a displacement of 1330 tons. The armament includes four 4·7in. guns and smaller guns, and eight torpedo tubes. The vessel is propelled by Parsons turbines, working through single-reduction gearing, the propeller speed at full power being 360 r.p.m. Superheated steam is raised in three express type Yarrow oil-fired boilers, working under forced draught. The new destroyer was selected by the Admiralty to carry out a long and exhaustive series of tests during which the water used and the fuel consumed were carefully measured. These tests showed a high level of efficiency, and the designed speed was also exceeded, an average speed of 36·3 knots being maintained on a six hours' full power trial, with the machinery developing slightly over 34,000 S.H.P. No attempt was made to exceed the power normally developed by "forcing." The performance of the destroyer is one which reflects great credit on the designers and builders, whose expectations were wholly fulfilled. Another destroyer of the same class, H.M.S. "Ardent," is now approaching completion at Greenock.

The Battersea Power Station.

SPEAKING at the annual general meeting of the London Power Company, held in London last Friday, the chairman, Mr. W. F. Fladgate, stated that progress was being made with the foundations and the river work for Battersea station, but that it would be necessary for the company, during the present year, to use every effort to expedite the work. It was the intention of all concerned to make the station the last word as regarded efficiency. The services of Sir Gilbert Scott, R.A., had, he added, been retained to advise on the designs already prepared by the company's engineer-in-chief and its architects. When the station was built it would form a notable addition to the architectural features of the Metropolis. At Tuesday's meeting of the London County Council, the General Purposes Committee commented upon the interim reports on the treatment of fumes from the station which had been issued by the London Power Company's advisers and by a committee presided over by the Government Chemist. It suggested to the Council that no action on its part was called for at the present time and that a final opinion on the method of controlling the emission of smoke and grit from the station should be deferred until the final reports of the company's advisers and of the Government Chemists' Committee had been issued. The General Purposes Committee added that it was understood that the method proposed to be adopted at the Battersea station was a combination of the cyclonic and water washing systems, and expressed the view that in order to contribute to the success of this method it appeared to be equally important that in addition to containing a low proportion of sulphur, the coal used should be of low ash content. The tests and proposals of the London Power Company for the removal of sulphur were recorded in our issue of November 29th, 1929.

Burst Tube in a High-pressure Locomotive.

THE Schmidt type extra-high-pressure locomotive "Fury," built for the L.M.S. Railway, met with an accident on Monday last. When entering Carstairs Station at slow speed one of the fire-box tubes burst at the point marked by a white star in the accompanying illustration. It so happened that at the moment the fire-box door had been opened to reduce the head of steam, and in consequence hot ashes and steam were projected amongst the four men who were in the cab at the time, so seriously injuring one of them—Mr. Schofield, of the Superheater Company, Ltd.—that he subsequently died. Two of the other three men on the footplate suffered minor injuries by burns and jumping on to the platform, the third, the driver, who remained in the cab, suffered no hurt. Except for the burst tube the locomotive is absolutely undamaged, not even the gauge glasses being broken. Had the door been shut at the instant of failure, it is probable that no serious results would have occurred. To prevent any possible chance of damage to life and limb in the unlikely event of a recurrence of the accident, it is not improbable that some kind of protective plate will be fitted to the fire-door. We ought perhaps to say, in fairness to the builders of the engine, the North British



Locomotive Company, Ltd., that the tubes in question were supplied to them ready bent, and they had only to expand them into the foundation ring. The usual cause of failure of a water tube, incrustation, is, of course, absent in this case, and the fractured tube is quite clean. The cause of the failure will be the subject of careful scientific investigation, and, though all engineers will surmise the nature of the fracture, nothing can be said about it for the time being.

Underground Railway Extensions.

THE Bills now before Parliament empowering the London Underground Companies to carry out improvements and extensions were approved a few days ago at special general meetings of the proprietors of the companies. The meetings were presided over by Lord Ashfield, who explained that the companies could not contemplate the carrying out of their improvements and extensions unless they received adequate assistance in the form of a grant from the Treasury. The major work for which the London Electric Railway Company sought powers was the extension of the Piccadilly section from Finsbury Park to Cockfosters, which would meet a long-felt want. Another important development was an extension westwards through Hammersmith to Northfields. Escalators and other station improvements were proposed at King's Cross, Hyde Park Corner, Knightsbridge, Dover-street, and Russell-square. It was also proposed to remove the Dover-street Station to a more convenient situation at the corner of the Green Park, near the Ritz Hotel, and it was intended that the Knightsbridge Station should be entirely reconstructed with surface stations, both in Brompton-road and at the top of Sloane-street. One of the problems was the speeding up of the whole system, which could not be done while the stations were situated closely together. The Metropolitan Railway was seeking powers to widen the line from Ravenscourt Park to Northfields, a scheme which would include the use of the disused Southern Railway line between Ravenscourt Park and Turnham Green, and the provision of two additional tracks from Turnham Green to Northfields. In conjunction with the widening, it was proposed to reconstruct the stations at Turnham Green, Chiswick Park, Acton Town, South Ealing, Northfields, Hounslow East, and Hounslow West. The construction of four lines west of Hammersmith would greatly accelerate services to Hounslow, Ealing, and Uxbridge. On the Central London Railway it was proposed to build a new station at Marble Arch, complete with escalators. The present interchange at British Museum, with the Holborn Station, was unsatisfactory, and it was proposed to construct a new deep level station. The City and South London Railway was also seeking powers to construct a subway connecting the Bank Station with the Monument Station. The total estimated cost of the whole scheme of works was approximately £12,000,000, of which extensions would account for £8,000,000.

Buyers of British Goods.

ON Wednesday, February 12th, a "National Roll of Buyers of British Goods" was established at a meeting held at the Mansion House, London, under the presidency of the Lord Mayor, Sir Wm. Waterlow. The object of the movement is to encourage individuals and firms to select British goods when making their purchases. Support for the scheme has, we are informed, already been secured from manufacturing firms and employers' and workmen's organisations. The founder of the movement is Mr. Noel Hammersley and its organisation is in the hands of Mr. Louis E. Wilson. The secretary, Capt. E. L. Frewen, has his offices at 1, Regent-street, London, S.W. 1. If the objects of the promoters are realised, the scheme will reduce the unemployment and under-employment of British workers and maintain their standard of living, and by increasing the demand for British goods will lower their cost of production and reduce their price.

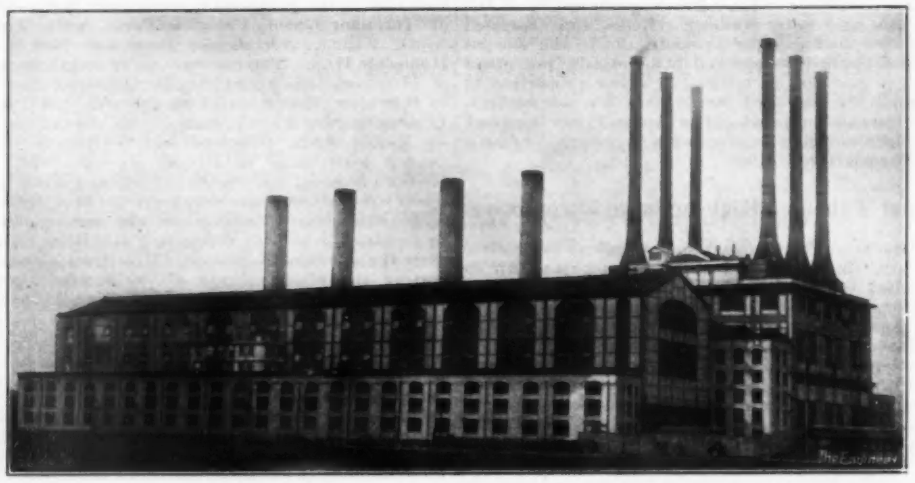
The Reclamation of the Zuyder Zee.

ON Monday, February 10th, the first two pumping stations for the draining of the north-west polder, to the south of the Island of Wieringen, on the Zuyder Zee, were officially put to work by M. Reimer, the Dutch Minister for Dykes and Waterways. In our issues of August 9th and 16th, 1929, we gave a full account of the reclamation work already done, and that now in hand. The two new de-watering stations for the polder now to be drained are situated one at Den Oever, at the eastern end of the Island of Wieringen, and the other at Medemblik, in the south of the island. The Den Oever station is equipped with two six-cylinder oil engines, each driving a horizontal-spindle centrifugal pump of 500 cubic metres per minute capacity. The Medemblik station, drawings of which were given in our issue of August 16th last, is equipped with three vertical-spindle pumps driven by alternating-current motors, the current being supplied from a North Holland power station at 50,000 volts and transformed to 5000-volt direct current at the motors. Each of the pumps has a designed capacity of 450 cubic metres per minute. It is hoped to remove the water now covering 20,000 hectares, or over 49,420 acres, of land in about eight months, the water being lowered at the rate of 2 cm. per day. When the dewatering work has been completed, the two pumping stations will then be utilised to maintain the level of the water at the polder level. It is understood that the cost of the work which has so far been done has exceeded the estimates, largely on account of high wages costs, but the Dutch Government is proceeding with the work as quickly as possible and hopes to complete it one or two years earlier than 1952, the year originally planned.

Television.

DIFFICULTIES in the direction of procuring the right kind of glass for lenses are said to be retarding the progress of television in this country. A few weeks ago the Baird Television Development Company, Ltd., announced that it would be in a position to put television sets on the market on the 1st of this month, but, owing to unforeseen difficulties in connection with the supply of lenses, the company has been unable to carry out its plans, although it is stated that sets will be available shortly. When tenders were sought for the supply of lenses, the lowest British quotation was £500 for 1000 6in. lenses and £200 for the same number of 4in. lenses. One of each size is required in the construction of a set, the larger one having a focus of 18in. and the smaller 12in. For the supply of 1000 4in. lenses a French firm quoted £87 10s., and the tender has been accepted. Assuming that the specification and terms of contract are precisely the same for French as for British makers, the great disparity between the British and French prices is remarkable, particularly when the 50 per cent. duty is taken into consideration. It is stated that the earliest date at which the British lenses could be ready was in three months' time.

ISSY-LES-MOULINEAUX POWER STATION



High-pressure Extensions to the Issy-les-Moulineaux Power Station.

THE distribution of electricity to private consumers in Paris dates from the year 1889, when the city was divided into five sectors, each served by a separate company. This arrangement lasted until 1913, when the advantages of unified control became so obvious that the supply of the whole city was taken over by a single authority under the name of the Compagnie Parisienne de Distribution d'Electricité. One of the first acts of the new company, which is known for brevity as the C.P.D.E., was to build two new central stations, one at St. Ouen in the north of Paris and the other at Issy-les-Moulineaux in the west. These stations were each laid out for a maximum capacity of 75,000 kW, but by a series of extensions carried out between 1917 and 1924 the capacity of the St. Ouen plant was increased to 250,000 kW and that of Issy to 80,000 kW. The company therefore had at its disposal in 1925 a total capacity of 330,000 kW. The continual increase in the demand, however, made it necessary to seek still further sources of supply. Arrangements were come to with the Union d'Electricité, which was building a second station at Vitry, for the service of its suburban area, and with the Société d'Electricité de la Seine, which furnished power for transportation purposes in the city and had a new station at Ivry, that part of the output of these plants should be reserved for the C.P.D.E. Power would also be available from the new hydro stations in the south of the country, but the supply from all of these sources had to wait for the completion of the new 60,000-volt interconnection system. Meanwhile something had to be done, if the estimated winter load of 1929 was to be carried with safety, and it was finally decided that the Issy-les-Moulineaux station should be extended to 175,000-kW capacity. The arguments in favour of this course were cogent. The capital expenditure would be less than would be required to build an entirely new station equivalent to the extensions of the old one. The new machines of modern design would, moreover, serve to take the base load of the station with great economy, leaving the older plant to deal with the peaks only, and thus materially raising the efficiency of the whole station.

Had the extensions merely consisted in the enlargement of the station along existing lines, the work would hardly have called for notice. It was decided, however, to take the opportunity of gaining practical experience of operating with much higher pressures and temperatures of steam than had hitherto been employed by the company, so that the knowledge acquired might be available as a guide to future design. The plant, therefore, was to constitute a working experiment on a large scale, and as such it has many points of interest.

To appreciate what has been done it is necessary to realise the conditions which had to be met. The existing turbine plant consisted of four 15,000-kW sets, and two sets of 35,000 kW, making an aggregate capacity of 130,000 kW at maximum continuous rating. Deficiency of boiler power, however, rendered much of this capacity unavailable. The boiler plant comprised forty units, each with a normal rating of 22,000 lb. of steam per hour, so that with all boilers in service little more than about 80,000 kW could be produced by the turbine plant. The boiler pressure, moreover, was low, steam being generated at only 13 kilos., or 185 lb., gauge, at a temperature no higher than 325 deg. Cent. (617 deg. Fah.). Another circumstance which had to be taken into account was the almost insuperable difficulty of doing anything to increase the capacity of the circulating water conduits which connected the station to the river Seine. Hence no great addition to the existing condensing plant could be provided without the risk of impairing the vacuum of the whole station.

The conditions which we have mentioned almost dictated the general nature of the solution to the problem. By putting down new high-pressure boilers and turbines, the latter arranged to exhaust at a pressure which would permit the steam to be finally expanded in the existing turbines, all the advantages of high pressure, high temperature steam could be secured without making any further call on the condensing equipment, and the total boiler capacity would be brought into better harmony with the capacity of the turbine machinery. The new plant, in short, would have the effect of "compounding" the station. This, therefore, was the plan decided on, though it was supplemented by the provision of another turbine designed for complete expansion of the high-pressure steam to condenser pressure, and arranged for steam to be tapped off for progressive feed heating. In accordance with this scheme, the back pressure against which the new high-pressure turbines were to work was automatically fixed at 14 kilos. absolute and the temperature at 325 deg. Cent., these being the existing steam conditions of the station. Starting from this fact, it was possible either to fix arbitrarily the upper temperature or the upper pressure of the steam, but not both, as one determined the other. An upper temperature of 450 deg. Cent. at the boilers, or 425 deg. Cent. at the turbines, was considered as high as it was prudent to adopt, and consequently a pressure of 36 kilos., or 512 lb., absolute at the high pressure turbine stop valves was decided on. A higher initial pressure might, of course, have been adopted by reheating the steam after its exhaust from the high-pressure turbines, but reheating was ruled out on account of the complications it would have involved. In order to allow a margin of pressure for the pipe losses and for the safety valves lifting the boilers were designed for a safe working pressure of 44 kilos., or 625 lb., absolute.

The next thing to be determined was the size of the additional turbine units. Since the limitations of the existing circulating water system rendered it inadvisable to increase the condensing plant of the station by more than 35,000 kW, this size was decided on for the new high-pressure condensing turbine. As regards the new back-pressure turbines, it was obviously advisable to make them at least big enough for their exhaust steam to supply the deficiency of the output of the existing boiler plant. To make them any larger than this would only be justified if the extra capital cost, including that of the extra high-pressure boiler plant involved, would be compensated by the increase in economy resulting from the better steam conditions. Furthermore, so long as the back-pressure section of the turbine plant was comparatively small, it could be operated at a very high load factor, leaving the relatively inefficient old machines the duty of dealing with the peaks of the load. The greater the capacity of the back pressure plant installed the less, of necessity, would be its load factor, until, in the limit, this would be reduced to the average load factor of the station, which was only about 24 per cent., and the extra cost would be insufficiently remunerated. A consideration of all these points indicated that the highest commercial efficiency would be obtained by compounding only the two 35,000-kW sets, leaving the four 15,000-kW sets to be operated with low-pressure live steam as before. It was also decided that each of the 35,000-kW sets should be compounded independently by supplying it with steam from one of the new high-pressure machines, thus constituting a pair of units each complete in itself. This course was considered preferable, from the point of view of efficiency at low loads, to the alternative of discharging the exhaust from the high-pressure machines into a common main, fed by the low-pressure boilers and serving all the low-pressure machines. As regards the capacity of the high-pressure machines, this was fixed at 11,200 kW each, so that the final solution of the problem took the form of two units of this size, each exhausting into one of the existing 35,000-kW units.

BOILER-HOUSE CONTROL BOARD

The steam conditions having been settled and the sizes of the turbines decided on, the next thing to do was to examine the most favourable thermal cycle. Calculations showed that the best efficiency could be obtained by heating the feed-water progressively to 170 deg. Cent. in three stages, by means of steam tapped off at pressures of 1 kilo., 5 kilos., and 10 kilos. per square centimetre respectively. The two compounded units did not lend themselves at all well to this arrangement, as the only practical

place at which to withdraw low-pressure steam from them was at the junction between the two turbines, where the pressure was 13 kilos. Hence it was decided that, under normal conditions, the whole of the steam required for the feed heating of the station should be tapped off from the new 35,000-kW high-pressure condensing unit, which could be constructed with the necessary facilities. In case of this unit being out of service for any cause, partially expanded steam could be temporarily obtained from the other set to maintain the feed-water temperature. The centralisation of the feed heating by confiding the work, normally, to a single turbine, had the result of largely reducing the capital cost, and at the same time of simplifying the pipe work. The whole of the condensate of the station, together with the make-up water, is taken first to the low-pressure heater, which is of the direct contact type, the level in the heater being maintained constant by a float regulator working in conjunction with a buffer tank. The low-pressure heater serves also as a de-aerator. From this heater the water is pumped at a pressure of 16 kilos. through the intermediate and high-pressure heaters, and then forced at a pressure of 45 kilos. into the boilers. The two latter heaters are constructed entirely of steel. The make-up water is obtained by distillation in two stages, the steam for distillation coming normally from the feed pump exhausts and passing away to the low-pressure heater.

For the supply of high-pressure steam six boilers were provided, each designed to evaporate normally 70 tons of water per hour, though capable of working through a range of from 20 to 120 tons evaporation, the latter for a period of two hours. Five of these boilers have been erected to begin with. The heating surface of each boiler is 1800 square metres, to which of the apparatus about 90 tons of water are required for every 120 tons of steam produced by the boilers. Except for the losses due to evaporation, the greater quantity of this water is recoverable, and could be used again after settling or filtration. At Issy-les-Moulineaux the water leaving the apparatus is employed to evacuate the ashes from the ashpit, boiler and flues.

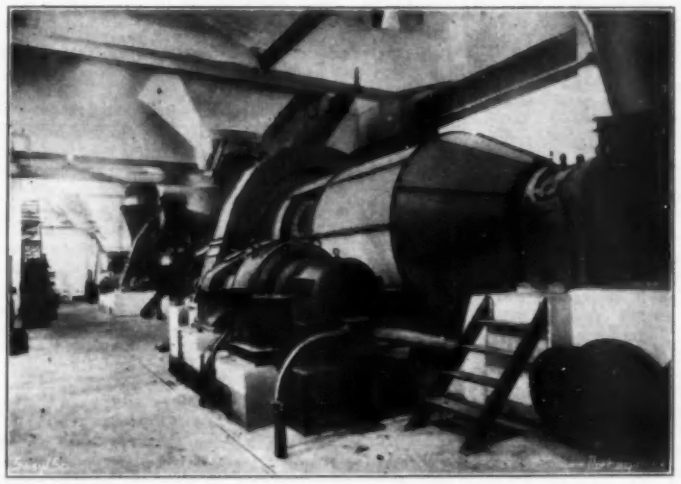
Two types of furnace are employed, three of them having a volume each of 500 cubic metres with finned water tubes in the walls, and the other two having a volume of 400 cubic metres each, with plain tubes set as close together as possible. Analyses and tests were made of samples of all the fire-brick used, the mean results being as follows :—

Chemical analysis, silicon 58 per cent., alumina 36·5 per cent., sesquioxide of iron 2·35 per cent., various impurities 3·15 per cent.
Apparent density, 1·88 grammes per cubic centimetre.
Porosity, as measured by water absorbed, 11·4 per cent.
Fusing temperature, about 1730 deg. Cent.
Collapsing temperature, about 1600 deg. Cent.
Softening temperature, about 1240 deg. Cent.
Permanent linear shrinkage, after heating to 1500 deg. Cent., 0·6 per cent.
Crushing strength at ordinary temperature, over 71 kilos. per square centimetre.

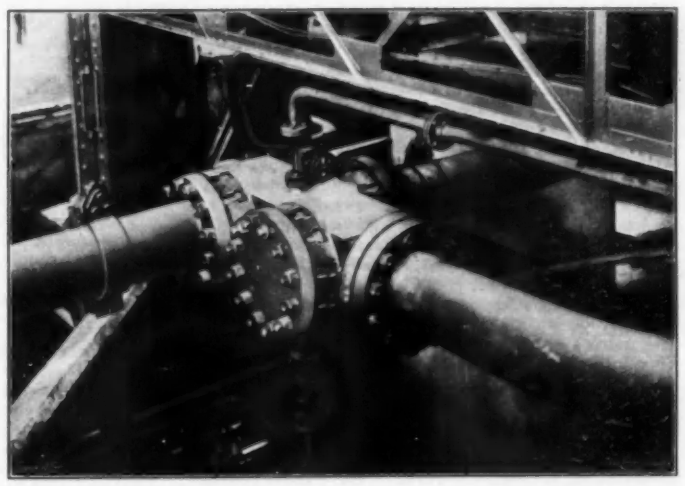
The bricks also withstood more than ten cycles of heating to 1200 deg. Cent., and sudden cooling by air before breakage occurred.

The boilers, which were constructed by three different firms, are of the three-drum bent tube type. The drums in all cases are of forged steel. The use of welded drums was considered, but though their construction was technically possible, the extra thickness of metal which would be necessitated by the softness of good welding steel caused their price meter as after the last operation, but about 12 m. long and of a thickness reduced to about 150 mm. A large number of heats was required for this operation. The tube, after straightening in the forge, if necessary, was machined inside and out, and a ring cut from each end for testing purposes. The weight after machining was about 30 tons. The tube was then taken back to the press and the ends closed to a hemispherical shape, either by "bottling" or by transverse forging. The finished drum was then heat treated to remove all forging stresses, the test rings undergoing the same treatment at the same time. After heat treatment the dimensions were checked, to see that the tolerances were not exceeded. The permitted tolerances were plus or minus 50 mm. in the length, minus zero or plus 3 mm. in the thickness, want of circularity plus or minus 1·5 per cent. of the external diameter, want of straightness 0·3 per cent. of the length of the straight part of the drum.

Test pieces cut tangentially from the test rings were specified to have an ultimate strength cold not less than 44 kilos., an elastic limit not less than 26 kilos., and an elongation not less than 16 per cent., while the sum of the breaking strength plus twice the elongation should not be less than 88. The metal was also to stand bending round a cylinder of three times its thickness without cracks. Hot tests were also specified. In these, at a temperature of 260 deg. Cent., when loaded with 16·5 kilos. for five minutes, the permanent elongation after cooling had to be less than ·002 of the distance between the reference marks. At 325 deg., with a load of 13·5 kilos., the same conditions had to be fulfilled. Furthermore, with loads of 15·5 kilos. and 12·5 kilos., at the above respective temperatures maintained for two hours, the elongation must not exceed ·002 of the length, or



COAL PULVERISING PLANT



HIGH-PRESSURE STEAM JUNCTION BOX

must be added about 200 square metres of water-screen surface. The coal is prepared in a separate pulverising house, with a capacity of 900 tons per day, which is much in excess of the maximum daily consumption. The plant comprises two rotary driers, fired by pulverised coal, each rated at 28 tons per hour. Each drier serves a pair of horizontal ball mills, rated together at the same capacity as the drier. Thus the nominal output of the plant can be obtained when working only 16 hours per day, or, alternatively, can be easily realised with only three of the mills in action. In addition to the stocks of raw coal, there is a bin for dry fuel, as well as bins for pulverised fuel both in the pulverising house and in the boiler hoppers, so that the stoppage of the preparing machinery for a few hours need not have a serious effect on the operation of the power station. On account of the high temperature of the feed, the boilers are not provided with economisers. A careful study of the conditions showed that it would not be economical to attempt to reduce the exit temperature of the flue gases below 140 deg. Cent., and to this end air heaters were installed with sufficient surface to effect this reduction, raising the temperature of the combustion air at the same time to 220 deg. Cent.

It was computed that with four of the new boilers working at maximum load about 5 tons of ash would be produced per hour. Of this, it was anticipated that about 1·5 tons would be deposited in the ash-pits, 1·0 ton in the boiler passes, and about 2·5 tons would be evacuated by the flues. The proximity of Paris and the nuisance which the discharge of so large a quantity of ash into the atmosphere would cause necessitated special precautions for cleaning the flue gases. The apparatus chosen is of the Hanrez type, consisting of six or eight staggered rows of elements. Each element is a prismatic tube of cast iron, 3·60 m. high, over the surface of which trickles a constant stream of water which rises up the interior of the tube and overflows at its upper edge. The gases flow across the banks of elements, and deposit their dust on the wetted surfaces, the dust being washed away constantly by the flow of water. For the operation to be very little inferior to that of drums forged from the solid. The drums are 10 m. overall length, with an internal diameter of 1·200 m. Their thickness ranges from 80 mm. to 88 mm., according to the number of tube holes required by the different constructors. The ends are hemispherical, each provided with a manhole of 300 mm. by 400 mm.

The metal employed is a basic Siemens-Martin steel with the following average composition :—

Carbon	0·25
Manganese	0·66
Phosphorus	0·013
Sulphur	0·025
Silicon	0·35

and a breaking strength of 46–52 kilos. per square millimetre. The metal is somewhat hard, partly to diminish the thickness necessary and partly to ensure a good hold for the tubes, which are of soft steel of 32–40 kilos. strength. The drum metal was specified to have an elastic limit of 15·5 kilos. at 260 deg. Cent. and of 12·5 kilos. at 325 deg. Cent. in tests lasting for two hours. The calculated factor of safety of the drums, based on the elastic limit at the working temperature, was 1·32.

For the manufacture of each drum, a 100-ton ingot was cast from two or three open-hearth basic furnaces. The ingot was withdrawn from its mould as hot as possible, namely, at about 500 deg. or 600 deg. Cent., and reheated to 1200 deg. Cent. It was then forged under a 6000-ton press to make it circular, and to show up any surface defects which might exist. The ends were then cut off and the centre trepanned out, the weight being reduced to 60 tons by these operations, and the dimensions being as follows:—Length, 3·0 mm.; diameter, 2·0 m.; and bore, 0·600 m. The next forging operation had for its object the increase of the diameter without increasing the length. It was done on a small mandrel, the metal being worked by a die parallel to the mandrel. At the end of the operation the bore of the ingot had been increased from 0·600 m. to 1·200 m., and the external diameter in a corresponding proportion. The ring so formed was then drawn out under the press to form a tube having the same internal dia-0·2 mm. on a 100 mm. test piece. The actual test pieces showed ultimate strengths, cold, varying from 46·2 kilos. to 51·5 kilos.; elastic limits varying from 26·3 kilos. to 31·5 kilos.; elongation varying from 26 to 29 per cent.; strength plus twice elongation varying from 96 to 107; and Charpy figures varying from 10 to 24 kilogramme-metres per square centimetre. All bending tests were satisfactory, the metal in most cases being bent double without cracks. In the hot tests all the permanent elongations were less than 0·02 mm., on a 100 mm. test piece, or less than one-tenth of the limit specified. The excellence of the metal had the effect of increasing the factor of safety sensibly above the figure of 1·32 estimated in the design.

In order to reduce the stresses due to temperature and bending, the piping for the high-pressure steam was kept to the smallest practicable diameter, although this entailed fairly considerable losses in pressure at full load. The actual diameter adopted was 250 mm. The lay-out provided for all the desirable flexibility, this being given by groups of small tubes in parallel, which would bend or twist under stress. Groups of this kind were arranged between the ends of the main steam pipes and the separators. The piping was erected in tension, so as to diminish the stresses under working conditions. The pipes are of weldless steel with loose flanges. Test pieces cut tangentially from them were required to show a permanent elongation, cold, of less than 0·2 per cent. after supporting a load of 12 kilos. per square millimetre at 450 deg. Cent. for an hour and a-half. The material for the bolts is nickel-chrome-molybdenum steel, which was limited to the same elongation after being loaded with 30 kilos. at 450 deg. Cent. for two hours. The bolt material was further specified to have an elastic limit under permanent load of 34 kilos. at 450 deg. Cent., and an ultimate strength under permanent load—creep strength—of 49·90 kilos. at the same temperature.

The separators are of forged nickel steel, 3·800 m. long, 0·700 m. diameter, and 50 mm. thick. The material was specified to have an elastic limit under permanent loading of 16 kilos., and a breaking stress

under the same conditions of 18 kilos., at a temperature of 450 deg. Cent. in both cases.

All the accessories of the high-pressure pipe system are of forged steel, except the bodies of the valves, for which cast steel was employed. The usual practice of using a very mild cast steel for the valve bodies was modified, a rather harder quality being considered advisable in order to retain a reasonable elastic limit at a temperature of 450 deg. The kind of metal selected is a carbon steel, giving, when heat-treated, an ultimate strength of 50 kilos., an elastic limit of 30 kilos. and an elongation of 24 per cent. The steel was manufactured in an electric furnace with basic lining, and has the following average analysis:—Carbon, 0·280; silicon, 0·250; manganese, 0·600; sulphur, 0·030; phosphorus, 0·030. The castings were annealed and then heat-treated. The actual results of tests of one cast, carried out at ordinary temperature, were as follows:—Ultimate strength, 52 kilos.; elastic limit, 32 kilos.; elongation, 24 per cent.; Charpy figure, 6·4. The same steel showed a permanent elongation of 0·1 per cent., with a load of 16 kilos, 0·17 per cent. with a load of 17 kilos., and 0·24 per cent. with a load of 18 kilos., each test lasting an hour and being made at a temperature of 455 deg. Cent. Other careful tests with Martens apparatus gave 9·5 kilos., as the limit of elasticity at 450 deg. Cent. under permanent load, 16 kilos. as the corresponding ultimate strength.

In giving this description of the extensions to the Issy-les-Moulineaux Power Station, we have aimed rather at concentrating on the facts and considerations of interest to designers than of submitting anything in the nature of a detailed account of the plant. Before terminating, however, a few words concerning the control of the boilers will not be out of place. At the end of the boiler-house is a series of panels, by means of which an operator can effect any change he may desire. To put more load on a boiler he presses a button marked "fast," and to take load off he pushes a corresponding button marked "slow." These buttons cause the rotation in one sense or the other of a controller, similar in construction to that of a tramcar. The controller in its turn varies the speed, simultaneously, of the motors driving respectively the coal-feeders, the induced draught fans, and the primary and the secondary air fans. The changes of speed of the motors, for any motion of the controller, are so adjusted that the proper correspondence is maintained between the fuel and air supply. A complete set of instruments indicates the conditions of combustion at any instant, and should some minor correction of any motor speed be desirable on account of changes in the quality of the fuel, or otherwise, this may be effected independently by the operator. The motors are all of the continuous current type. There are, for the service of each boiler, three motors, aggregating 21 H.P., driving the coal feeders, two motors together developing 540 H.P. for the induced draught fan, two motors together equal to 138 H.P. for the secondary air fan and another pair of motors totalling 31 H.P. for the primary air fan. Combustion is regulated entirely by varying the motor speeds, no dampers being used in the flues or air ducts. The boiler stop valves are controlled from the same central board. These valves are opened and shut hydraulically by means of the pressure on the feed line. The instruments on each boiler panel include a pressure gauge, a steam flow meter, a feed water indicator, a CO_2 meter, a $CO + H_2$ meter, and indicators showing the primary and secondary air flow, the combustion chamber pressure, and the length of the flame. This latter indicator is really a pyrometer measuring the temperature at a fixed point in the combustion chamber. There are also voltmeters indicating the conditions of fan motor speeds, graphic recorders of the steam flow, and the flue gas composition, integrating meters for steam and feed water, a flue gas temperature recorder, and a water-level indicator. A special panel carries instruments common to all the boilers, namely, an integrating and recording wattmeter, an indicating wattmeter, a steam-pressure gauge, a feed water pressure gauge, a superheat temperature recorder, &c.

Various views of the station and of the new plant are given herewith and on page 188.

Atmospheric Pollution in 1928-1929.

By JOHN B. C. KERSHAW, F.I.C.

THE fog which enveloped London on Tuesday, January 21st, was an unpleasant reminder to the health authorities of the Metropolis that they have not yet overcome the very serious evils of smoke, nor removed the dangers and inconveniences which accompany thick fog. This last fog was very unfortunate in the time of its occurrence, for it not only delayed the opening of the Naval Conference, but caused many of our visitors to make unfavourable comparisons between the atmosphere of London and that of Paris and New York. Londoners, however, may extract some comfort from the fact that the figures of atmospheric pollution for the year 1928–29 are lower than any yet recorded during the twelve years the London gauges have been in operation, and below the writer gives a series of tables for the air pollution observations, in continuation of those that have appeared in THE ENGINEER for many years past on this subject. As was stated in the last article —THE ENGINEER, February 15th, 1929—the official reports upon the results of the observations are now published by the Department of Scientific and Industrial Research, and lag nearly two years behind the observations which they record. The fourteenth annual report, containing figures for the period ending March 31st, 1928, is also not yet available, and for this and last years' article it has been necessary to fall back on the figures of air pollution published annually in the reports of the Meteorologist to the Corporation of Southport. The author's thanks are due to Dr. J. S. Owens, who has compiled the figures published in these reports, and to Mr. Joseph Baxendell, of Southport, for permission to use them in this article.

NUMBER OF GAUGES IN OPERATION.

During the twelve months ending March 31st, 1929, there were eighty-one deposit gauges in operation in this country, maintained by thirty-three public authorities, with twelve automatic air filters maintained by seven authorities. These numbers are the same as for the preceding year, but changes have occurred locally.

During the year six new gauges were set up, namely, three at Sheffield and one each at Newcastle-on-Tyne, at Rotherham, and at Stoke-on-Trent; but as five gauges at Rochdale and one at Cardington were discarded, the total for the year remains unaltered at eighty-one.

THE LONDON RESULTS.

From Table I. it will be seen that there is a marked decline in the amount of solid deposit in the last year at every station in the London area, and that the general average for the year ending March 31st, 1929, is considerably lower than that for the previous year. The results obtained by the two observation stations at Kew have, of course, helped to lower the average, but when the comparison is confined to the eight older stations, there is still noticeable a considerable improvement in London's atmosphere. Table II. reveals more clearly how great this improvement is.

TABLE I.—*London's Soot and Dust Fall, in Metric Tons per 100 Square Kilometres.*

Station.	1926–27.	1927–28.	1928–29.
Meteorological Office	11,856	11,556	10,200
Archbishop's Park	14,976	13,320	10,512
Finsbury Park	10,080	11,064	9,408
Ravenscourt Park	11,664	8,688	7,872
Southwark Park	10,104	13,008	11,940
Victoria Park	8,244	8,184	7,212
Wandsworth Common	7,416	9,540	7,020
Golden-lane	18,588	23,268	15,480
Kew Observatory A	—	6,864	6,240
Kew Observatory B	—	7,788	6,828
Westminster	—	—	9,840
Averages for all Stations	11,622	11,328	9,323
Averages for eight stations	11,622	12,328	9,955

TABLE II.—*London's Soot and Dust Fall from 1915 to 1929, in Tons per Square Mile.*

Year.	Total solids in tons.	Three-year averages.
1915–16	451	
1916–17	427	436
1917–18	431	
1920–21	304	
1921–22	284	296
1922–23	300	
1923–24	286	
1924–25	298	279
1925–26	254	
1926–27	297	
1927–28	315	284
1928–29	239	

The total solid deposit in 1928–29 was equivalent to 239 tons per square mile. This is not only the lowest yet recorded for London, but is also little more than one-half of that recorded for the first year of the observations with the standard form of gauge in 1915–16. The decline has been regular and continuous, save for the check which occurred after the coal-mining stoppage of 1926. The cause of the increase which occurred in the two following years was discussed in the article of February 15th, 1929, and it is not necessary to review the matter further in this article, since this setback to the improvement of London's atmosphere is now seen to have been temporary and not permanent in character. London, with an average of 239 tons per square mile, occupies a very good position in Table V., which shows the comparative position of twenty-four cities and towns for which the results of the observations of 1928–29 are available, and Edinburgh is the only other large city which occupies a better position.

THE GLASGOW RESULTS.

Table III. contains the figures for Glasgow's soot and dust fall expressed as metric tons per 100 square kilometres for the three successive years, 1926–27, 1927–28, 1928–29. The results for last year cover seven stations only, since, owing to some of the results being incomplete, the returns for the gauges at Blytheswood-square and at Victoria Park are not included with the others. The omission of these results makes it impossible to compare satisfactorily the last year's results with those of the previous years, since the two stations omitted have always collected the highest deposit in the Glasgow city area. However, even with these stations omitted, Glasgow, following London, effected an improvement in 1928–29, for the total amount of solid matter collected in each separate gauge was considerably less, with the exception of that collected in Alexandra Park, than in the preceding year. The details given in Tables I. and III. however, show how necessary it is to have gauges installed in every district of a large city if any correct idea of the average amount of atmospheric pollution in such cities is to be obtained. The Golden-lane district of London, for example, shows twice as much solid pollution as the Wandsworth Common district, and almost three times as much as Kew Gardens; while in Glasgow the Blytheswood-square and Victoria Park gauges have collected in the past over 50 per cent. more solid deposit than the gauges placed in Alexandra Park or Queen's Park.

TABLE III.—*Glasgow's Soot and Dust Fall, in Metric Tons per 100 Square Kilometres.*

Stations.	1926–27.	1927–28.	1928–29.
Alexandra Park	9,120	9,924	12,084
Bellahouston Park	9,336	10,212	9,708
Blytheswood-square	14,076	15,768	—
Botanic Gardens	11,412	13,032	10,596
Queen's Park	9,552	10,116	7,560
Richmond Park	11,100	12,768	11,844
Ruchill Park	9,156	10,512	9,072
Tollcross Park	13,080	12,576	11,316
Victoria Park	13,932	17,484	—
Averages for all stations	11,196	12,488	10,310

Table IV. gives the Glasgow figures for the whole fifteen years, expressed as tons per square mile per annum. From this table it will be seen that the total deposit in 1928–29 of 264 tons was the lowest since 1923, and is only some three-fifths of that recorded for the first year of the observations; but, of course, the omission of the Blytheswood-square and Victoria Park figures has improved Glasgow's average for 1928–29.

TABLE IV.—*Glasgow's Soot and Dust Fall from 1915 to 1929 in Tons per Square Mile.*

Year.	Total solids in tons.	Three-year averages.
1915–16	409	
1916–17	368	405
1917–18	438	
1920–21	325	
1921–22	254	278
1922–23	254	
1923–24	321	
1924–25	285	294
1925–26	275	
1926–27	286	
1927–28	320	290
1928–29	264	

RESULTS FROM OTHER TOWNS AND CITIES.

Table V. gives the figures for the total deposit of solid matter for twenty-four of the English and Scotch towns and cities in which the air pollution observations are being carried on at the present time, the results being expressed as tons per square mile. When studying these figures it must be noted that comparisons of the results can only be made fairly between towns possessing two or more gauges, since it is quite impossible for a single gauge to be so placed as to give a fairly representative figure for the air pollution of a town of any size or importance. The

TABLE V.—*Comparative Figures for the Total Fall of Solids in Twenty-four Cities and Towns of the United Kingdom for the Past Two Years, expressed as Tons per Square Mile per Annum.*

Place.	1927–28.		1928–29.	
	Gauges.	Tons.	Gauges.	Tons.
Rothamsted	1	126	1	99
Bournville	2	159	2	112
Southport	2	143	1	117
Cardiff	1	356	1	206
Stoke-on-Trent	1	222	1	207
Wakefield	1	378	2	208
Edinburgh	2	199	3	214
Marple	1	267	1	215
Kingston-on-Thames	1	162	1	225
Gloucester	1	330	1	232
London	10	290	11	239
Birmingham	2	258	2	254
Leeds	4	351	4	261
Glasgow	9	319	7	264
Leicester	1	388	3	271
Loughborough	—	—	1	336
Kingston-upon-Hull	—	—	1	353
Rochdale	10	420	4	362
Huddersfield	2	453	2	394
Rotherham	1	380	1	397
Salford	3	529	—	—
Newcastle-on-Tyne	3	558	3	558
St. Helens	1	575	1	578
Liverpool	1	570	1	651

deposits obtained with one gauge therefore can only be employed for showing whether at that particular spot in the town or city concerned the air pollution over a series of years is decreasing or diminishing. The results obtained at Rothamsted, near St. Albans, are the only exceptions to this rule, since it is in a purely agricultural district, and the results obtained with the one gauge give a reliable indication of the average air pollution in that district of Hertfordshire.

Bearing these considerations in mind, the results gathered in Table V. may now be studied in detail. Group 1 contains the towns with deposits under 200 tons per square mile per annum, and only three are sufficiently free from air pollution to be classed in this group, namely, Rothamsted, Bournville, and Southport. The 1928–29 results, however, show considerable improvement upon those of 1927–28, and Rothamsted with a deposit of only 99 tons occupies the first place, and is followed by Bournville and Southport, with deposits of 112 and 117 tons respectively.

Turning now to consider the relative positions of the towns and cities in Group 2, with deposits ranging from 206 to 271 tons per square mile per annum, one can cut out the three towns near the head of this group, namely, Cardiff, Gloucester, and Stoke-on-Trent, since it is evident from the results obtained that the one gauge in use must have been placed at the cleanest spot in each of these towns, and the figures therefore are useless for comparison with those obtained in other places. Wakefield, Edinburgh, and London rank therefore as the three towns in this group with the lowest amount of air pollution, while Birmingham, Leeds, Glasgow, and Leicester follow in their rear, in the order named. The figures for each of these towns and cities, with the exception of Edinburgh, indicate considerable improvement, and it is noteworthy that the number of places in Group 2 is increasing, while the number in Group 3 shows a corresponding decline. The time is not far distant, in the writer's opinion, when London will attain the honour of being grouped with Rothamsted, Bournville and Southport in Group 1, and this transfer to a higher class will come all the more quickly if Londoners will make more general and adequate use of the various forms of smokeless fuel which are now at their disposal and are obtainable at any of the larger gasworks of the Metropolis.

The eight towns in Groups 3 and 4, with deposits between 300 and 400 and between 500 and 600 tons per square mile respectively, do not call for any special comment; but as several of them have one gauge only the results from Rochdale, Huddersfield, Salford, and Newcastle-on-Tyne are alone comparable. It is an extraordinary coincidence that the average deposit for Newcastle-on-Tyne in 1928–29 is the same as for the preceding year, for the amount of solid matter collected in the three gauges has been different, and it is only on adding them together and taking the general average that the figures yield the same result. The gauge at City-road, in fact, collected a larger amount of solid impurity than in 1927–28, the total being 979 tons, as compared with 913 tons. Central Newcastle, therefore, possesses the dirtiest atmosphere of any place in which the observations are made at the present time.

Liverpool, with a total deposit of 651 tons, is another of the very few places which show an increased deposit for 1928–29, and some explanation of the consistently bad position which that city occupies in these tables appears to be called for. The Liverpool gauge is placed in one of the dirtiest quarters of the city, namely, in Netherfield-road, at the North end, where it collects not only all the soot and smoke from the shipping in the docks, but also from the works and factories which abound at that end of the city. Other towns, when they instal their single gauges, generally select the cleanest and not the dirtiest spot for this purpose, and it might be advisable for the health authorities of Liverpool to consider the installation of two or three more gauges in order to obtain a fair average value for the air pollution of their city.

THE SULPHUR IMPURITIES OF LONDON'S ATMOSPHERE.

The controversy which was carried on last year concerning the possible increase of sulphur impurity in London's atmosphere as a result of the operations of the super-power station now being erected at Battersea for the London Power Company, gives additional interest to the figures recorded for the SO_3 at the various stations within the London greater area.

TABLE VI.—*The Amounts of Sulphur Deposited in the London Gauges for the Years* 1927–28 *and for* 1928–29, *Expressed in Tons of SO_3 per Square Mile per Annum.*

Locality.	1927–28.	1928–29.
Archbishop's Park	51·6	39·0
Finsbury Park	31·9	26·4
Golden-lane	74·9	39·0
Kensington, South	36·2	28·5
Kew Observatory A	30·4	25·8
Kew Observatory B	34·4	27·6
Ravenscourt Park	28·8	23·6
Southwark Park	38·4	32·5
Victoria Park	27·6	23·6
Wandsworth Common	27·3	22·1
Westminster	—	27·0
Averages	38·1	28·6

Table VI. contains the details of the sulphur present in the deposits of solids collected in each of the London gauges for the years 1927–28 and 1928–29, the results being expressed as tons of SO_3 per square mile per annum. In the latter year the total sulphur ranged from 22 tons at Wandsworth Common up to 39 tons at Golden-lane, and at Archbishop's Park at Lambeth, while the average for the whole of the eleven stations was only 28·6 tons per square mile per annum. This is a very low return, and it must be noted that there has been a very striking reduction compared with the average for the previous year which was 38·1 tons. This reduction is owing to the act that the amount of sulphur in the Golden-lane gauge in 1927–28 reached the surprisingly high figure of 74·9 tons, which is nearly double that of the past year. Table VII. contains the figures of the total amount of sulphur found in the London and Glasgow gauges, during the whole period of the observations, the totals being based on the averages for all the gauges installed in these two cities. This table brings out very clearly the great improvement which has been made during the fifteen years in the atmosphere of both Glasgow and London, not only in regard to the total amount of solid air pollution, but also in the amount of gaseous impurity. It would be noticed that the London figures given in Table VI. cover results for a new observation station at Westminster. This station has been equipped by the D.S.I.R., and the data collected there should prove of considerable value when the Battersea station is put into use, for it will show to what extent the air pollution of this quarter of the Metropolis is being increased.

TABLE VII.—*The Total Amounts of Sulphur Collected in the London and Glasgow Gauges for the Period* 1916 *to* 1929, *Expressed as Tons of SO_3 per Square Mile per Annum.*

Year.	London.	Glasgow.
1915–16	72	92
1916–17	68	89
1917–18	60	84
1918–19	70	77
1919–20	53	59
1920–21	27	42
1921–22	25	34
1922–23	36	38
1923–24	33	41
1924–25	41	51
1925–26	32	46
1926–27	40	43
1927–28	38	50
1928–29	29	38

The figures already collected at Westminster, indicate that the total deposit of solid matter, namely, 251 tons, and the sulphur contents of the deposit, namely, 27 tons, approach very closely in amount to the average for the whole of the London observing stations, which were 239 tons and 28·6 tons respectively. Whether these figures will be increased when the new Battersea power-house is operating remains to be seen.

NOTES UPON AIR POLLUTION IN SALFORD, LANCASHIRE.

No results from Salford are included in Table VI., owing to incomplete returns from some of the gauges. The 1928 report of the Salford Medical Officer of Health contains, however, a section devoted to the subject of air pollution in that city, and as the health authorities of Manchester have never allowed their own figures for air pollution to be published, some space may be given to the data furnished by Dr. Osborne for the twin-city on the Irwell, in South-West Lancashire.

The results of the observations in Salford are given in Table VIII., and are based upon the monthly averages at Peel Park, which is the only station that has been in operation for the whole period. The average annual solid deposit, expressed as metric tons per 100 square kilometres, is 16,802, and the figures have shown little variation, excepting in the year 1927–28, when the solid deposit rose to 21,552 metric tons per 100 square kilometres. The tar contained in the deposit also increased in that year to a maximum of 996 tons, and the sulphur to a maximum of 3240 tons, as compared with the averages of 594 tons and 2568 tons respectively. The causes of the increased air pollution in that year were discussed in last year's article on this subject; but it is of interest to note how greatly they affected the Salford figures.

TABLE VIII.—*The Results Obtained in the Salford (Peel Park) Gauge for the Six Years ending March* 31*st*, 1929, *Expressed as Metric Tons per Annum per* 100 *Square Kilometres.*

Year.	Tar.	Total solids.	Sulphur as SO_3
1923–24	300	16,044	2,352
1924–25	360	15,564	2,400
1925–26	588	15,600	2,604
1926–27	840	16,512	2,544
1927–28	996	21,552	3,240
1928–29	480	15,540	2,268
Averages for six years	594	16,802	2,568

Table IX. contains a comparison of the results at Peel Park with those of the more densely populated districts of Birmingham, Glasgow, and Leeds. Dr. Osborne in commenting on these returns, points out that although the figures for the amount of total solid impurity show little variation, the character of the deposit varies greatly, since in Salford it contains from three to four times as much tar and also more solid carbonaceous matter than are found in the central areas of other cities.

TABLE IX.—*Comparison of the Average of the Salford Results for the Years* 1923 *to* 1927 *with those of other Towns, Expressed as Metric Tons per* 100 *Square Kilometres per Annum.*

Town.	Tar.	Total solids.	Sulphur as SO_3.
Birmingham (Central)	156	15,804	1,872
Glasgow (Blythswood-square)	192	13,408	1,920
Leeds (Hunslet)	132	16,152	1,908
Salford (Peel Park)	516	15,924	2,472

These two constituents of the deposit form what is generally known as the sooty matter of air pollution, and are what one would naturally expect in a city where the working classes are packed closely together in small houses, equipped with old-fashioned grates and kitchen ranges, in which cheap bituminous coals are burnt.

According to Dr. Osborne, little appreciable improvement can take place either in the atmosphere of Salford or that of any other industrial city, until a much larger section of the public gives up the practice of burning raw fuel. Increasing numbers of people are using now some form of smokeless fuel such as gas coke or Coalite; but the number will have to be greatly increased before any considerable increase of atmospheric cleanliness can be expected.

In connection with the efforts now being made in Salford to educate the public as to the merits of gas coke, as a domestic fuel, some very interesting experiments have been carried out with that fuel and with low-temperature coke and Welsh steam coal in the new type of open grate which has been installed in all the public health offices in Salford. The details of the construction of this particular form of grate have been given in earlier reports, and the 1928 report, which is now being quoted. gives the figures for the results of the experiments carried out during last winter with the three different forms of smokeless fuel named above.

The results were as follows:—100 lb. of coke produced locally by carbonisation in vertical gas retorts yielded the same heating effect as 113 lb. of a low-temperature carbonised fuel and as 128 lb. of Welsh steam coal. The test proved therefore that ordinary gas coke produced in vertical gas retorts has a 25 per cent. greater heat value per pound than Welsh steam coal.

Figures were given in the last report to show that vertical retort coke is 50 per cent. better than ordinary house coal for domestic heating purposes, and that it takes much less time when once ignited to yield a hot fire. The chief obstacle to the general acceptance of smokeless fuel in place of raw coal, especially by small householders, is the doubt as to whether carbonised fuel will heat an ordinary cooking oven. In order to settle this point a special oven was erected in one of the Salford municipal houses, and was constructed in such a manner that, although placed behind the fire grate, the door opened into the room on the other side of the wall. By constructing the oven in this way the fire grate itself is in the living-room while the oven opens into the scullery. The grate and oven were fired with the ordinary vertical retort coke, and it was found that both the oven and a boiler could be raised to a temperature of 300 deg. Cent. without any difficulty at all. Representatives of firms engaged in the manufacture of working-class grates have inspected the experimental coke-fired oven at Salford, and are taking up the manufacture of special grates and ovens constructed on these lines for the combustion of coke and other smokeless fuels in working-class houses.

Dr. Osborne states in closing this section of his report, that demonstrations of the use of vertical retort coke were given daily at a Health Exhibition at Salford in December, 1928, and that they aroused much interest. He also states that he himself has used nothing but this type of coke, both in his home and at the municipal health offices in Salford for some years, and that he would not willingly use raw coal again in his household. The following extract from his report shows the necessity that the coke used for domestic purposes should be quite dry: "Gas coke is still largely neglected as a domestic fuel. Yet a good dry gas coke gives an ideal fire, where the householder is sufficiently interested to learn how to use it. The expression dry gas coke is used advisedly, as, unfortunately, much coke is still supplied to the public in a very wet condition. Vertical coke, *i.e.*, gas coke prepared in modern vertical retorts, should be quite dry, and yields magnificent fires in the all-fire-brick grate; also it is inexpensive, the cost being only about half that of coal fires. It is most desirable that gas undertakings should consider this aspect, when new gas retorts are being installed. Coke should not be regarded as merely a by-product of secondary importance. The time may not be far distant when this substance will be the primary consideration. Some gas undertakings have already installed plant for the production of low-temperature coke."

Obituary.

SIR WILLIAM HOY.

THE death of Sir William Wilson Hoy deprives South Africa of a noted railway administrator, and the railway world in general, of an outstanding figure. Sir William was born at Kinross, Scotland, in 1868. In 1880, at the age of 12, he entered the service of the North British Railway at Edinburgh. Nine years later he left his native country for South Africa, where he received a post with the Cape Government Railway Service. He made steady progress. In 1897 he was appointed assistant traffic manager at Bulawayo. In 1898 he was transferred in the same capacity to Kimberley and a year later, the fateful year of 1899, to Port Elizabeth. Following the progress of the Boer War he was appointed in June, 1900, traffic manager at Bloemfontein, and was placed in control of the Imperial Military Railways—the name given to the railways of the Transvaal and the Free State as they were captured, length by length. When the war ended in May, 1902, the railways were transferred to civil administration, and Hoy was appointed Chief Traffic Manager of the Central South African Railways with headquarters at Johannesburg. In 1909 he became assistant general manager of the C.S.A.R., and in 1910 he succeeded to general managership on the death of his father-in-law, Sir Thomas Price. In that year the Union of South Africa came into being and Hoy was appointed General Manager of the South African Railways and Harbours. On his shoulders fell the responsibility for organising and administering the important railway developments which constituted an essential part of the scheme of Union. He remained in charge of the South African railway system until 1927, by which time the mileage under his control had increased to 11,558, including 1331 miles acquired by conquest in German South-West Africa. In 1916 he was knighted for his services in connection with the South-West African campaign, and six years later was promoted to K.C.B. It has been said of him that he demonstrated that the State ownership of railways is not necessarily inconsistent with the attainment of a high degree of efficiency. He had no major interests outside his work and found joy in meeting the almost limitless demands which it made on his abilities.

HENRY HOLGATE.

MR. HENRY HOLGATE, of Montreal, a civil engineer of international reputation, died on January 21st, in his sixty-eighth year. He was born in Milton, Ont., and during the earlier years of his career was engaged in railway construction in connection with the Canadian Northern Railway. Removing to Montreal in 1894, he was engaged for some time with the Royal Electric Company, and built and operated the Montreal Park and Island Railway.

Four years later Mr. Holgate went to Jamaica as manager of the West India Electric Company, and constructed and managed the hydro-electric tramway system at Kingston, Jamaica. In 1901 he returned to Montreal and entered into partnership with Robert E. Ross. During the ten years of partnership the firm constructed many hydro-electric plants, including those of the West Kootenay Power Company and the Canadian Copper Company.

In 1906 Mr. Holgate investigated for the Dominion Government some matters in connection with the Trent Valley Canal, and was appointed Chairman of the Commission to investigate into the collapse of the Quebec Bridge in 1907. He became president of the Cedar Rapid Power Company in 1911, and was later consulting engineer for the same company. He was also appointed one of the board of consulting engineers to report on the future development of Montreal Harbour. Recently, in conjunction with J. A. Jamieson, he conducted an exhaustive inquiry into the St. Lawrence deep waterway proposals for the Montreal Board of Trade, and arrived at the conclusion that the project was uneconomical and needless.

SIR JOHN ESPLEN.

IT is with regret that we have to record the death, on Friday of last week, at Kensington, of Sir John Esplen, the chairman of Esplen and Son, Ltd., of Liverpool, and of Esplen, Son and Swanston, Ltd., of London. Sir John was born at Blundellsands, near Liverpool, in 1863, and received his early education at Liverpool College. He was apprenticed to Fawcett, Preston and Co., Ltd., of Liverpool, and gained further experience with Earle's Shipbuilding and Engineering Company, Ltd., at Hull. On the completion of his training he joined his father, the late Mr. William Esplen, in the business of consulting engineers and naval architects. He subsequently became a partner in the business and was instrumental in establishing branches of the firm at London, Cardiff, Buenos Aires, New York, and Monte Video. In later years he became the chairman of both the Liverpool and London companies, and was also a director of many other undertakings connected with shipbuilding and shipping activities. During the war he was Director of Oversea Ship Purchase at the Ministry of Shipping, and for his services he was made a K.B.E. in 1918 and was created a baronet three years later. Few men have had wider business connections with world shipping and shipbuilding interests than the late Sir John Esplen, and his death at a comparatively early age will be very deeply regretted.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FUNDAMENTAL PRINCIPLES OF MEASUREMENTS.

SIR,—I beg to draw the attention of your readers to the broadcast address by Sir J. J. Thompson on "Tendencies of Recent Investigations in Physics," as reported in the *Listener* of January 29th, 1930. I fear the great value of this address as a corrective to those tendencies of which Professor Einstein is the symbolic head will be missed by the majority of your readers through lack of acquaintance with detail. The following remarks, I am bold to suggest, fall in line with Professor Thompson's attitude of mind and might help to elucidate some of his witty remarks. Although Professor Thompson stands firmly for classical mechanics and applied mathematics, it must be acknowledged that there is an urgent need for a radical change in the methods of teaching mechanics and mathematics, particularly the calculus.

MECHANICS.

Mechanics has to do with force, matter, and motion. We do not know what force *is*; our best notion of force is obtained from the exertion of our muscles; but we do know what force *does*. It imparts acceleration to matter. We cannot easily define matter, yet we all have some idea as to what matter is. Certain ideas we must assume to be primary conceptions which all human beings possess, built up in our minds from every-day experience and incapable of scientific analysis into simpler notions. The human mind has its limitations. A round ruler cannot measure its own circumference, much less can a ball measure its own diameter; and we must be content to confine our scientific investigations to the sphere prescribed by psychological limitations. Every rational scientist keeps a sharp eye on his instruments and apparatus, and every conscientious researchist will claim no greater accuracy for his results than what is permitted by due allowance for experimental error. So, too, the true "natural philosopher" keeps his own mental limitations well in view.

Thus in mechanics there are certain fundamental notions which must be regarded rigidly as primary conceptions; any attempt to analyse these—that is, to express them in terms of simpler conceptions—being regarded as contrary to all principles of human thought, or, in other words, irrational. As far as mechanics is concerned, these primary conceptions consist of space, motion, matter, time, force—each one being inextricably associated in our mind with others of the group.

Now I said at the outset that force imparts acceleration to matter. This is a short way of saying that force accelerates the velocity of matter, or makes matter move faster and faster. We are therefore confronted at once with a notion, rather difficult to grasp, namely, acceleration; but until this idea is mastered the student will never understand mechanics. And acceleration cannot be apprehended unless velocity is clearly recognised, and the meaning of "instantaneous velocity" or $\frac{ds}{dt}$ well seen. Clearly, then, there is some preliminary ground to be broken before we can discuss the statement that force imparts acceleration to matter. The grand thing about acceleration is that, unlike velocity, it is not "relative," but retains its value whatever be the Galilean system of reference.

We think of two points in space. It is the lawful privilege of the human mind to imagine pictures which in some measure correspond to the external world of material reality, but which are divested of some of the limitations of real nature. (Frictionless pulleys are of great value to engineers as mental "apparatus.") It is a valuable privilege when not abused. It allows us to concentrate our attention on what for the moment are essentials and to avoid distraction with what are temporarily non-essentials. This is the glory of mathematics—a glory which in unwise heads can soon be turned into a shame. In mathematics we can design bridges which when constructed will convey trains over chasms; so, too, can we build castles in the air which, although their ephemeral courtyards can be surveyed and mapped with all the detail of ordnance topography, would never find the physical universe which tolerated the materialisation of our fairy-land scheme. We assert our privilege, the prerogative of human thought, to picture in our minds "things" which have not, and could not have, material existence. Euclid's geometry—remember that "geometry" means "earth measurement"—remains yet one of the finest scientific gifts to the human race on account of its bold rejection of impertinent material limitations with a view to its own philosophical freedom and subsequent application to practical mensuration. With its points without size and lines without thickness, it remains so truly faithful to the world of physical reality that it serves for the measurement or design of the countless number of approximately rigid bodies in the universe, be they crystals, machines, houses, bridges, fields, continents, or planets. And, what few recognise, it also constitutes the one and only "rigid" mental framework with reference to which, and to which alone, the evolutions of the most fabulous of four-dimensional jelly-fishes or of Wonderland-Alices can be adequately measured in the laboratory of n-dimensional space. It is only in the sense that Boyle's Law is "hyperbolic" that the so-called non-Euclidean "geometries" are geometrical; they are at best merely systems of arbitrarily assigned algebraic relationships having no necessary association at all with what the plain man calls space.

We think of two points in space. They are Euclidean points; humble mental tools, hard to describe, yet sufficiently well known to be of use to everyone. You can think about them although you cannot picture one of them nor put one on paper. Yet you can put a dot on your paper, and a dot will do quite well if it is not too large—much better than writing $lt_{r\to 0}\pi r^2$ or any other cumbersome algebraic symbol. Either the dot or the algebraic symbol are mere symbols of an indescribable, useful "thing."

For some purposes, as in plotting graphs from experimental data, a large dot is not objectionable. Its clumsiness is no grosser than the coarseness of the experiment; but a small circle may be preferred. When plotting graphs from equations—hypothetical data—however, large dots and circles are too coarse; a pin-prick or—to ease the eyes—a small cross is to be recommended, and there the coarseness of the "point" is no worse than that of the pencil line to be drawn through it.

We think of a straight line joining our two points. We cannot easily define a straight line in words, but we all have a sufficiently clear idea as to what a straight line is, and can easily think about it.

Even if we have to picture in our minds a line with thickness, we know the Euclidean line has no thickness, so that our imperfect mental picture does not betray us to an incorrect mental conception. In our ordinary processes of thought we are content with the most hazy or grotesque mental pictures, because these are but symbols or "counters" corresponding to the more vital and clear conceptions in our deeper psychical being.

So we think of the straight line joining two points in space. Everybody knows that the "length" of this straight line is the "distance between the points." We imagine the distance between the points to change, and then we say that motion takes place. Motion, fundamentally, to the researchist is an effect in his own consciousness. Motion cannot be completely defined in words, although it can be described in terms of other primary conceptions such as distance and time. No *Weltanschauung*—a neat word, much used in Germany, meaning "conception of the world" or "philosophy of nature"—then, can eliminate mind (that which experiences consciousness) or regard it as an effect of action (*i.e.*, of motion) since motion itself is fundamentally, as far as the human investigator can go, an effect in consciousness. There is no sharp line of demarcation between the sciences of psychology and mechanics, any more than there are boundaries between the three arbitrarily formed divisions of mechanics—dynamics, statics, and kinematics.

* * * *

It is usual to divide mechanics into three branches—dynamics, statics, and kinematics. The division is primarily a matter of convenience, and is open to objection. Dynamics is usually associated with force and bodies relatively in motion, statics with force and bodies relatively at rest. A misleading inference is apt to be drawn. Statics is but a special application of dynamics to bodies "at rest," and hence to the study of framed structures, walls, dams, &c., and of the stresses within strained bodies; but all the so-called fundamental principles of statics belong primarily to dynamics. Force imparts acceleration to matter. If the acceleration is nought, it by no means follows that there are no forces acting on the matter. It may be that a thousand forces are acting, but, owing to mutual opposition, their net effect is nil. How such mutual neutralisation can take place is the function of the subordinate science, statics, to investigate. But statics remains a branch of dynamics. We recur to this later.

We learn from experience that to change the relative position of two real bodies originally at a constant distance apart and to fix a new relative position involves the exercise of force. But, again asserting our right as thinkers to discard temporarily unnecessary considerations, we may study the motion and neglect the forces acting, in which case our study of motion irrespective of any forces involved is called kinematics. Of course, we cannot design a workable locomotive on purely kinematical considerations, but as our minds are only human, we might temporarily neglect "force" considerations when designing, say, the valve gear and link motion.

Kinematics thus becomes an important subdivision of mechanics, and, indeed, with kinematics we should make our real start.

KINEMATICS.

I have spoken of the relative position of two bodies, and at the outset we must get rational ideas as to the meaning of relativity. The distance between the two points we thought of is, as far as kinematics is concerned, absolutely the distance between them. I say "as far as kinematics is concerned" not because the qualification is immediately pertinent, but because I want to warn the student straight away that in the province of kinematics he is on dangerous ground. The real world is more than kinematical; it is dynamical, so that by temporarily losing sight of force considerations we may get betrayed into expressions which will afterwards ruin us. But so far, so good.

Let the distance between our two points increase. We

say that motion takes place. Or let the distance diminish. Again we say that motion takes place. Thus we get the ideas of longer and shorter distances, and our ideas are quite clear even though we cannot say how much longer or how much shorter the distances are. This leads to the measurement of distances. We compare a short straight stick with a long straight stick—a little crookedness in both does not matter—and we find that by repeated application of the shorter to the longer the longer is equal to five times and a bit of the shorter.

If we use the same short stick for measuring other approximately straight things, we have chosen our unit of length. But in most measurements there is a bit at the end, and this bit may or may not be neglected, according to the purpose in view. So we subdivide our standard unit—really in so doing we choose a smaller unit. Nevertheless, the problem of the bit remains to-day an unsolved difficulty. We always have to be satisfied with an approximation in practice, even if in mathematics we call the neglected bit "....." (as in 3·14....), or call the whole length sine theta or epsilon. Anyway, we say that such lengths are, not immeasurable, but incommensurable. They do not contain even our tiniest unit of length an exact number of times. If there is no odd "bit," or if we cut off the troublesome "bit" and throw it away, as when cutting a piece to size in the workshop, then we say that our length is commensurable.

Now suppose we wished to measure the circumference of a circular disc, our straight stick would be valueless. We might be able to bend it to the correct curvature—it then becomes a curved unit, applicable only to circles of the same radius—in which case approximate measurement is possible, but in the process of bending we should stretch some of its fibres and compress others, making absolute accuracy impossible of attainment.

And if we had cut a piece of string long enough to embrace the disc, and then stretched it straight, we could not guarantee that the length of the string had not altered.

Of course, for all practical purposes, such objections are trivial and vexatious, but in strict mathematical philosophy the question must be faced, Is it lawful to measure a curved line with the "straight" unit of length? Strictly speaking, it is not lawful. The curved line belongs to a different family from the straight line; their lengths are not commensurable; they have not a perfect common factor. Hence at the commencement of any mensuration of curved lines, we have to make a compromise.

But could we not have rolled our disc on a flat surface and have noted how far it had travelled in one rotation? In practice, yes. In philosophy, no. A perfectly circular cylinder would skid on a perfectly flat surface. There must be teeth, no matter how small, to allow of rolling; or, in other words, our cylinder must have a many-sided polygon for its profile instead of a circle, or our flat surface must be a rack which indents the disc, thereby creating teeth on its circumference.

Measurement of a curve by "rolling" on a straight edge is only the same in principle as "stepping off" the curve with dividers set at a very small distance apart. The accuracy of the result increases the shorter the distance between the points of the dividers, but absolute equality of length between a straight line and a curve is as unthinkable mathematically as is a straight line of 3in. radius; which means that the mathematician is not making an absolutely unexceptionable statement when he says that the arc of a circle is, say, 6in. long, or even that it is equal to its radius when the angle subtended is a radian. He is assuming that curved inches are equal to straight inches, which absolutely they are not. Of course, this is hair-splitting with a vengeance, but modern mathematicians will tolerate no superfluous "half-hairs" or "billionth-hairs" either. The microscope of infinite magnifying power must reveal no fault in modern mathematical thought. So we must face the problem of curved inches and straight ones. It lies at the root of a controversy which has racked learned heads for two and a half centuries.

J. J. ELLIOTT.

Technical College, Huddersfield,
January 31st.

CAN ECONOMICS BE MADE AN EXACT SCIENCE?

SIR,—In your issues of January 31st and February 7th both Sir Alfred Herbert and Mr. Gaudin agree that unity of thought cannot be expected on economic questions, Mr. Gaudin giving the reason that economics is not an exact science.

Unfortunately, both gentlemen are right.

Philip in his book "The Dynamic Foundation of Knowledge," if he does not specifically state, at least suggests the following, which goes far to bring economics under the rules of an exact science.

Economics.—The science which deals with the creation and distribution of wealth.

Wealth.—Matter with property and forms which fit it to supply human needs and wants, available to humanity.

Creation of Wealth.—Matter as found in Nature (with the exception of certain wild fauna and flora), has to be changed by analysis and/or synthesis and transformed in form before it becomes wealth.

Matter can only be changed in properties and forms by the application of energy, therefore energy is the sole creator of wealth.

Accept that, and at once economics comes under the laws which govern the action of energy on matter—there you bring economics to an exact basis at once. It is not suggested that economists should write in the terms of units of energy, but more thinking in these terms would do much to induce clarity in the "Dismal Science."

M. B. LAMB.

Brechin, Angus, February 8th.

South African Engineering Notes.

Pneumatic Picks do Fine Work.

VERY successful results have attended the employment of pneumatic picks in the Rustenburg platinum field of the Transvaal. By this new method of mining it has been found that so far as the oxidised platinum ore is concerned, the use of explosives is eliminated, with consequent economy, not only through saving the cost of explosives, but also in time, in that drilling is not delayed during the shift on account of blasting operations. Pneumatic picks are also rendering good service on the Black Reef at the Randfontein Mine. As in the platinum belt, mining costs are reduced to a minimum, and good profits are being secured from ore of medium grade in narrow stopes.

Road Motor Services.

At the end of November the Railway Administration had in operation 10,908 miles of road motor services, an increase of 1241 miles in comparison with November, 1928. In addition, 1530 route miles have been authorised, and will be introduced within the next few months, and when that position has been reached the route mileage of road motor services operated will be nearly equal to the number of open miles of railway. During the past year approximately 110 additional vehicles were placed in service, the total number of vehicles operated at the present time exceeding 400. The majority of the vehicles put into traffic since last November have been six-wheeled types, capable of carrying a net load of 10,000 lb. The provision of such large vehicles is enabling the Administration to extend its activities considerably, with resultant benefits to its customers. With the provision of higher-powered vehicles, trailer working has been resorted to in a greater measure than before, particularly in the Orange Free State, where large quantities of maize and wool traffic have been given rapid transit, net loads of 10 tons, consisting of 5 tons on the vehicle and 5 tons on a trailer, being hauled at one time. Experiments are at present being conducted with vehicles capable of conveying loads of 10–15 tons net with trailers.

Union Miniere Copper Output.

In September last the Union Minière copper mine, in the Belgian Congo, produced 12,800 tons of rough copper. That record production brings the total output of the first three-quarters of this year to 100,400 tons copper against 86,555 tons in the corresponding period of last year. The Union Minière, even at its present rate of production, is the largest single producing unit in the world. In 1928 it was fourth, coming just after Utah Copper, Nevada Consolidated, and Chile Copper. Now it leads the list of the world's copper producers, and when the present extensions to the plant at Panda are completed, the productive capacity of the company can be further, and considerably, augmented.

Plant for the Union Iron and Steel Works.

The specifications for the plant and equipment, &c., required for the Pretoria Iron and Steel Works were issued towards the end of last year by the South African Iron and Steel Industrial Corporation, Ltd. There are to be initially two blast-furnaces, each capable of producing 350 tons of pig iron per twenty-four hours, but so designed that they can be lined for a normal output, at the commencement of operations, of 250 tons per day. The mixture of ore normally charged to the furnaces will contain 52 to 58 per cent. of metallic iron. Coke will be produced at the works and the coke oven gas will be drawn off and used for furnace heating in the steel furnaces and rolling mill sections of the works. The blast-furnace gas will be cleaned in an electrical dust precipitation plant and used for heating the blast and for steam-raising under boilers, the balance going to a gasometer for distribution to the various reheating furnaces, &c. A slag granulating plant is to be installed, and the granulated material dispatched by rail, whether for railway ballast or for road-making is not specified. The blast-furnaces are to be fed by double inclined skip hoists and charging apparatus of the double-bell revolving distributor type, capable of handling more than the quantity of materials required for a 350-ton daily output. Four stoves are to be installed for each furnace, and each is required to provide a minimum of 70,000 square feet of heating surface. It is pointed out that owing to the refractory nature of the ore a high blast temperature, in the region of 1500 deg. Fah., will be required. The cast house is to be equipped with two 15-ton, 60ft. span, travelling cranes, to handle pig, in conjunction with lifting magnets. Electric drive is to be used in all sections. The various smaller sizes of motors from 100 H.P. downwards are to be standardised as far as possible throughout the works, and definite speeds are laid down for each size.

The furnace equipment in the steel-melting department will at the outset comprise four 100-ton tilting basic open-hearth furnaces, and one 400-ton metal mixer will be installed. It is pointed out that as at the outset the quantity of scrap available is expected to be small, steel will be made by the "pig and ore" process, but using such scrap as is available. The plant is to be capable of extension by the addition of five more similar furnaces. The molten iron from the blast-furnaces will be taken by ladle and teemed into the mixer. From the mixer it will be poured into 50-ton ladles, weighed, and carried by one of two 100-ton casting cranes to a point below the charging platform, and thence lifted by 75-ton hot-metal cranes and delivered to the furnaces. The latter are to have hearth dimensions on the slag line of approximately 40ft. by 14ft. They will be heated normally by blast-furnace and/or coke oven gas, but in case of shortage there is to be a producer plant capable of gasifying 1200 tons of coal a week of 150 hours.

The melting department requires a big equipment of travelling cranes, as follows:—Two 15-ton, 85ft. span for handling scrap; two 75-ton, 73ft. span for charging the mixer; two 100-ton, 73ft. span to serve the charging bay. These cranes will have a 20-ton auxiliary hoist. Two 15-ton, 80ft. span to serve the ingot mould shop. In addition, there are to be two furnace charging machines, capable of handling standard metal boxes weighing, with charge, 7½ tons each. The furnaces are to be tipped into 60-ton casting ladles, and the steel cast into 3-ton ingots.

The rolling mill section will be required to handle 3-ton ingots, and to turn out the following finished products:—(*a*) Rails up to 110 lb. per yard; (*b*) joists up to 12in.; and (*c*) sheet bars, 8in. to 12in. by ¼in. to ⅝in. Plates up to 6ft. by 30ft., and all other sections of channels, angles, tees, fish-plates and sleepers, rounds and wire rods down to 0·2in. diameter, squares, flats, &c.

The rolling plant section will comprise soaking pits, preheating furnaces, blooming mill, finishing mills, hot bunks, and finishing departments. The blooming mill is specified as a 34/36in. two-high electrically driven reversing mill capable of rolling 3-ton ingots into either slabs of a maximum width of 30in. or into blooms drawn down to 4in. The rail and structural—heavy—mill is to be 28/30in., either three-stand, two-high, with one or two driving motors, or three-stand, three-high, with one driving motor. It is to be provided with a cambering machine for rails, and, in addition, to a hot saw equipment. Attached to this mill will be the railway sleeper department that will produce steel sleepers of the standard type in use on South African railways, up to a maximum of 7ft. by 10in., weighing about 134 lb. This section will be complete with pressing, punching, and dipping equipment to turn out a finished sleeper, inspected and ready for use. The medium mill will be a three-stand, three-high, continuous, electrically driven unit, 18/20in., complete with finishing section and a fish-plate plant capable of providing all fish-plates required for the rail tonnages mentioned in the schedule, finished and ready for use.

The plate mill will be three-high, electrically driven, and must be capable of producing plates of a maximum sheared size of 30ft. by 6ft., in thickness from ⅜in. to ⅝in., and will have a special plate-finishing department attached with mangles, shears, and the like.

The merchant and rod mill design is left to tenderers, who are invited to submit their standard electrically driven types, subject to the mill being of modern design, capable of fast working. A big installation of furnaces is required in this section, namely, three soaking pits, an ingot preheating furnace, reheating furnaces for the large and medium mills, a continuous reheating furnace for the latter, two reheating furnaces for the plate mill and one for the merchant mill. The last-mentioned furnace is to be heated by coke oven gas only, but the remainder are to be capable of handling producer gas or a mixture of blast-furnace and coke oven gases. As in the steel melting section, a producer gas plant of suitable size will be installed.

Rhodesian Railway Traffic.

The receipts of the Rhodesia Railways for the twelve months ended September 30th last amounted to £5,423,787, an increase upon 1928 of £318,327. This is a clear indication of the effect of the developments which are taking place, particularly in Northern Rhodesia. The quantity of coal carried in the period under review was 915,066 tons, compared with 900,176 tons in 1928. The previous record tonnage of chrome ore railed—247,145 in 1927—was just exceeded in 1929 with 248,188 tons. Copper was 85,858 tons, compared with 99,298 tons, but zinc increased from 7368 tons in 1928 to 12,238 tons. Traffic continued heavy throughout November and engines and wagons were employed to the fullest extent. The first of the eight heavy type "Garratt" locomotives, 2–8–2—2–8–2 wheel arrangement, began to arrive at the end of last year, and when placed in service will be very welcome. At present it is necessary to "pool" the majority of main line locomotives in order to cope with the heavy business, *i.e.*, to work them out from the home station as soon as ready without waiting for the regular drivers.

Engineering in Cape Town.

Statistics recently published show that nearly 3000 Europeans are engaged in engineering in Cape Town. There are to-day two large engineering works, with nineteen smaller shops, in addition to the large railway workshops situated at Salt River. The statistics reveal the fact that 1030 fitters and turners, 60 blacksmiths, 30 welders, 50 sheet steel workers, and 360 apprentices are in those workshops. In the Salt River workshops there are 138 of a salaried staff, 650 artisans, 237 apprentices, and about 1400 other employees. The value of the machines installed in these shops is approximately £431,000. As regards cost of production, the engineering industry in Cape Town cannot compete in a satisfactory manner with the oversea manufacturers of agricultural machinery and plant, which is admitted at little or no duty, and is produced in countries where the wages for fully qualified mechanics are much lower than what are paid in South Africa. Engineering firms in South Africa have not a big home market, such as have Britain and the United States. Consequently they cannot afford to go in for mass production. Yet the industry is not only making marked progress in every direction, but it is also keeping up to date with the best machines that engineering science can devise. With the establishment of an iron and steel industry in the Transvaal, secondary manufactures depending upon the use of these materials will naturally arise, and the Cape Town engineering firms should obtain a good deal of the extra work.

FARADAY SCHOLARSHIP EXAMINATIONS.—The annual examinations for a Faraday Scholarship of eighty guineas per annum, tenable for two years in college and one year in manufacturing works, and for a Maxwell Scholarship of sixty guineas per annum, tenable for two years in college and one year in works, will be held at Faraday House on April 8th, 9th, and 10th, 1930. Exhibitions may also be awarded to candidates who acquit themselves creditably in the above examinations, but who do not obtain the necessary number of marks to qualify for the Faraday or Maxwell Scholarship. The subjects of examination for the Faraday Scholarship are geometry, algebra, trigonometry, dynamics, statics and hydrostatics, geometrical and freehand drawing, chemistry and physics. For the Maxwell scholarship the subjects are mathematics, dynamics, statics and hydrostatics. Further particulars may be obtained from the Registrar, Faraday House Electrical Engineering College, 62–70, Southampton-row, London, W.C. 1.

Projects for Tunnelling the Straits of Gibraltar.

IN a recent issue our contemporary *Le Génie Civil* published an interesting review of various proposals which have, from time to time, been suggested for constructing tunnels under the Straits of Gibraltar. This subject, which has attracted public attention spasmodically at intervals for a number of years past, has recently again been brought prominently forward by the action of the Spanish Government in appointing a commission of engineers to investigate the possibility of linking up the two continents in this manner. A shaft has been sunk at Tarifa, some 12½ miles south-west of Gibraltar, and a corresponding shaft is being sunk at a point on the Moroccan coast, the object being to ascertain the nature of the beds through which the proposed tunnels would have to be driven.

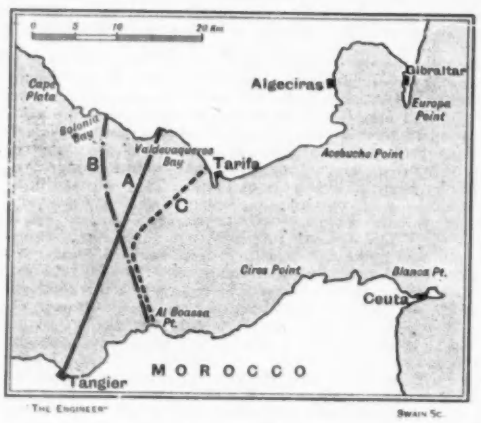


FIG. 1—THE STRAITS OF GIBRALTAR

As our contemporary points out, the idea of forming a tunnel under the Straits of Gibraltar is by no means new. As long ago as 1869 an engineer, Laurent de Villedemil, propounded a scheme for the purpose. He was followed by the Spanish generals Rubio and Sotomayor, the Spanish engineers Mendoza and Garcia Faria, the English engineer Kimber, and the French engineer Berlier, who all investigated the subject more or less completely, and made a number of suggestions. Then, too, definite proposals have been made by Ibáñez de Ibero and Lieut.-Colonel Pedro Jenevois. The schemes of the two latter are discussed at some length by our contemporary, as is also that of Berlier, and we purpose in what follows to give the gist of them. Before doing so, however, it would be well, perhaps, to consider briefly the geographical conditions of the district.

At their narrowest place, that is to say, between Guadalmesi Point in Spain and Cirès Point in Morocco, the Straits of Gibraltar are only 13,800 m.—say, 8 miles 5 furlongs—wide. Unfortunately, it is just between those two points that the greatest depths of water are met with. Depths of from 2500ft. to 3250ft. are encountered, and it would be manifestly impossible to take a tunnel down to such depths as that, on account of the heavy gradients which would have to be employed, if for no other reason. Further west in the Straits, however, the water is shallower, though still fairly deep—some 1300ft. or so—but the distance between the two coast lines is considerably greater, being in the neighbourhood of 20 miles. It is in this region that it is generally considered that it would be the best for the tunnel to be made. A study of the geological conditions of the region suggests, according to our contemporary, that the two continents were separated by a cataclysm, which would account for the depth of water in the Straits, the geological formations of both coasts are identical, being mainly eocenes and chalks. To the eastward permeable beds are met with, but to the westward the strata are described as being impermeable and quite favourable for the driving of a tunnel. At the narrowest place, however, there is apparently an outcrop of hard compact rock on the sea bed.

To illustrate its remarks, our contemporary shows in a map the routes of the tunnels proposed by Berlier, Ibáñez de Ibero, and Jenevois. Its essential features are reproduced in Fig. 1. The full black line A indicates the route taken by the Berlier Tunnel and by the tunnel first proposed by de Ibero. The dot-and-dash line B shows the route chosen by de Ibero for his second proposal, while the broken line C indicates the route advocated by Jenevois. Berlier presented his scheme in 1897. His tunnel was to have a total length of some 41 kiloms., of which 32 kiloms. would have been under the sea. A profile of it is given in Fig. 2.* As will be seen, it was suggested that, by a long incline of between 13 kiloms. and 14 kiloms., a short length of level, and then another incline of 6 kiloms. or so, the tunnel should reach a depth of about 430 m. below sea level in a length of 21 kiloms. That would represent an average climb of some 110ft. per mile, or a gradient of just over 1 in 50. Then, after a length of level of some 3 kiloms., there was to be a continuous climb for the remaining 17 kiloms., during which the 430 m. would have again had to be mounted, the gradient being rather more than 1 in 40.

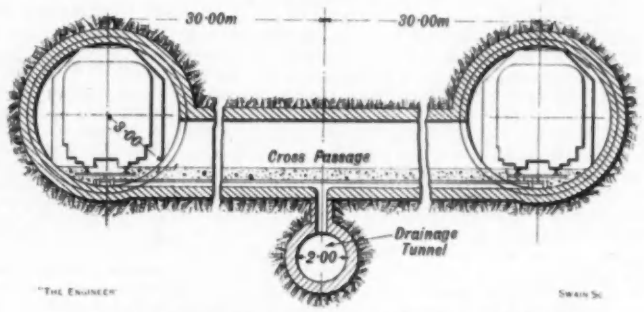


FIG. 6—CROSS SECTION OF THE JENEVOIS TUNNEL

level line of 1000 m. each. This alternation of inclines and levels was introduced to give the locomotives a series of periods of comparative rest during the climb, so that overheating of the motors might be avoided. At the lowest point, which was to be reached in a length of 21·6 kiloms., there was to be a 5 kiloms. length of level, after which the ascent to the African coast was to be made in a similar manner, lengths of 1 in 40 alternating with 1000 m. lengths of level, sea level on the African side being reached at a point 9·6 kiloms. from the coast. The total length of the tunnel was to be 48·2 kiloms., of which 32 kiloms. would be under the sea. It will be observed that the amount of cover allowed for at the lowest point was 44 m., or just over 144ft.

In the second project, the greatest depth to be negotiated was —360 m., as compared with —396 m. in the first project. It was proposed that the tunnel should start at a point 8·9 kiloms. inland on the Spanish side, and that it should descend by alternating inclines, each 3 kiloms. long with gradients of 1 in 50, and level portions, each 500 m. long, to the lowest point, —420 m., where there was to be a level portion 800 m. long. Beyond the latter, the tunnel was to climb in a similar manner, sea level being reached on the African side at a point 13·6 kiloms. inland. The total length of the tunnel was to be 50·3 kiloms., of which 27·3 kiloms. would be under the sea.

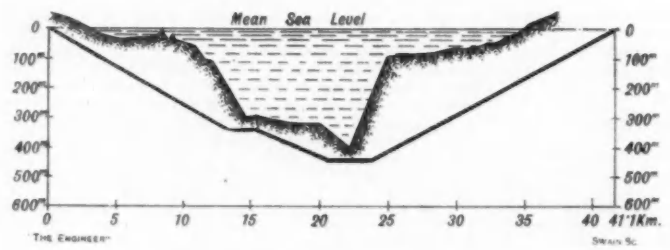


FIG. 2—THE BERLIER PROJECT

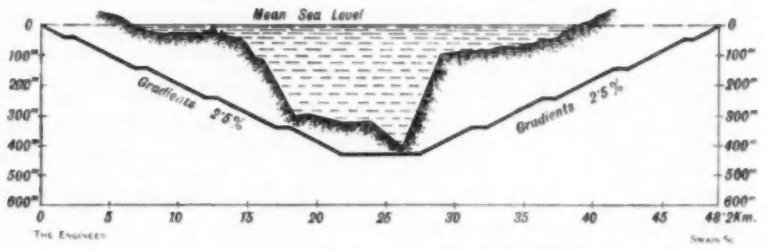


FIG. 3—THE FIRST DE IBERO PROJECT

The first project of Ibáñez de Ibero, the general secretary of the Institut d'études hispaniques at the University of Paris, was launched some twenty years ago. He studied three routes :—

(1) From the Bay of Valdevaqueros, west of Tarifa, in Spain, direct to Tangier ;

(2) From the Bay of Bolonia, west of Valdevaqueros Bay, to between Al-Boassa Point and Karkusch Point on the African coast ; and

(3) From Cape Trafalgar, which is higher up the coast than is the Cape Plata seen on the map, to Malabata Point, on the opposite side of the bay to Tangier.

In his first project, in which he found that the maximum depth encountered was 396 m., the tunnel was to begin in Spain at a point 6·6 kiloms. from the coast and was to descend to the lowest point to be reached, *i.e.*, —440 m., by a series of inclines—see Fig. 3—each 4 kiloms. long and each having a gradient of 1 in 40, these inclines being separated by lengths of

Of the third project, our contemporary only remarks that as the length of the tunnel would have to be over 75 kiloms., it was less advantageous than the others.

In all three cases de Ibero suggested that there should be two parallel tunnels—see Fig. 4—each 6 m. in internal diameter, arranged with their centre lines 16 m. apart, connected together at intervals by cross passages. Excavation was to be effected by driving ahead of the main tunnels, a smaller tunnel, 3 m. internal diameter at one side of and below the level of the main tunnels. This smaller tunnel was to serve for the driving of the main tunnels by means of cross passages and also for the evacuation of the the excavated material and any water that might enter the working.

It was suggested that the gauge of the rails should be 1·44 m., which is, curiously enough, practically the standard gauge almost everywhere else in Europe except in Spain ! The trains were, of course, to be electrically propelled, and it was anticipated that passenger trains weighing from 400 to 600 tons could pass through the tunnel in half an hour. The author of the projects estimated that the first would take from five to six years to carry out, and that the cost would be 330 millions of pesetas. Taking the peseta

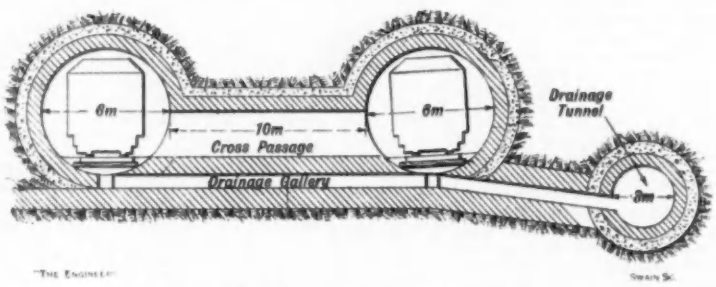


FIG. 4—CROSS SECTION OF THE DE IBERO TUNNELS

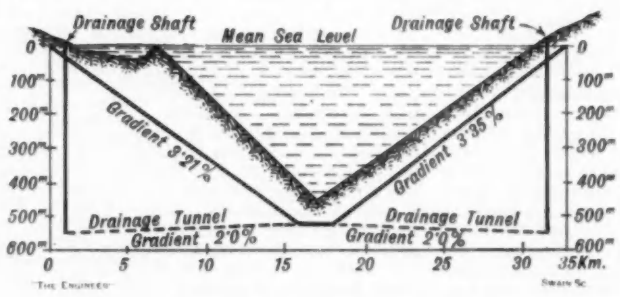


FIG. 5—THE JENEVOIS PROJECT

* It should be explained that Figs. 2, 3 and 5 are all drawn to the same scale. They, like the other engravings in this article, are produced from the article in our contemporary.

at 25 to the £1 sterling, which was probably about where it stood when the calculation was made, that would represent an outlay of some £13,200,000. The estimated cost of the second project was of the same order, while the calculated cost of the third project is given as being 500 millions of pesetas, or, say, £20,000,000.

The project of Lieut.-Colonel Pedro Jenevois, a Spanish artillery officer, is for the driving of a tunnel between Tarifa in Spain and Al-Boassa Point in Morocco. This scheme, our contemporary explains, has been inquired into by the Spanish Minister of Public Works, with the result that the Commission referred to above has been appointed. It is suggested that the tunnel should not be straight, but that, after running first of all for some distance to the south-west, it should sweep round in a gentle curve till it pointed slightly east of south, and then run straight again to the Moroccan coast. A profile of it is given in Fig. 5. It is suggested that, for a length of 16 kiloms. after

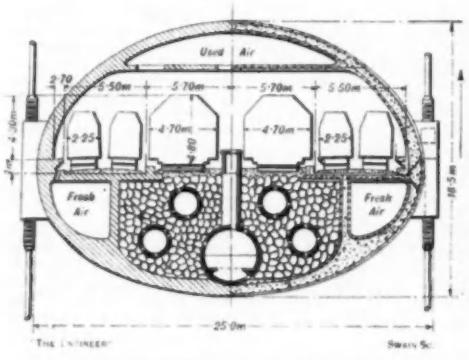


FIG. 7—CROSS SECTION OF HERRERA TUBE

leaving the Spanish Coast, it should have a down gradient of 1 in 31·2, then a length of 1500 m. of level, beyond which it would mount by a continuous gradient of approximately 1 in 30 to the Moroccan coast. On each side, it is suggested, there is to be a drainage tunnel with a gradient of 1 in 50 running from the central level portion of the main tunnels to the coast, where it would communicate with an evacuation shaft, the bottom of which would be at a level of 550 m.—just over 1800ft.—below sea level. The amount of cover above the tunnels at the lowest point would be from 60 m. to 80 m., say, from 200ft. to 260ft. The length of the tunnel would be 33 kiloms.

As in the de Ibero projects, it is proposed that there should be two main tunnels parallel to one another, each with an internal diameter of 6 m., but in this case at 60 m. centres—see Fig. 6. They would be connected at intervals of 200 m. by oval-shaped cross passages, 2·7 m. high and 1·5 m. wide, with their floors at rail level. The drainage tunnel, the suggested

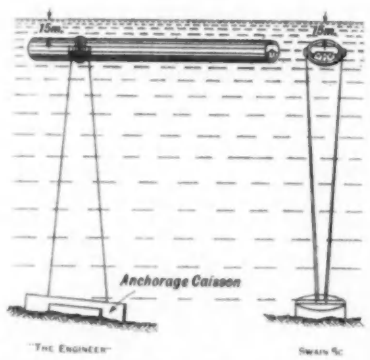


FIG. 8—METHOD OF ANCHORING HERRERA TUBE

diameter of which is 2 m., would be arranged below and midway between the two main tunnels. All three tunnels would be lined with masonry, the thickness in the main tunnels being 0·7 m., and in the drainage tunnel 0·5 m. The permanent way would be equipped for the passage of both standard gauge and Spanish rolling stock, and for that purpose would be laid with three rails, as was the Great Western line in the broad-gauge days.

Colonel Jenevois calculates that the cost of his scheme would be 300 millions of pesetas—or, at the rate of between 9000 and 10,000 pesetas per lineal metre. Taking the peseta at its present value of about 38 to the £1 sterling, the outlay would be just under £8,000,000, and the cost per metre-run, say, from £235 to £260. The annual cost, including maintenance, interest on outlay and sinking fund, is put at about 690,000 pesetas per kilometre. Colonel Jenevois estimates that at the outset 700,000 passengers and 700,000 tons of goods would be carried annually. It is proposed that each passenger and each ton of goods should pay 10 pesetas, so that the revenue would be 14 million pesetas, which would represent a deficit of over 8 millions. It is thought, however, that that condition of affairs would not last for more than a few years, and that very soon the receipts would more than cover the expenses. As soon as the number of passengers and the tonnage of goods reached 1,100,000, the undertaking would be self-supporting, while with 1,600,000 passengers and 1,000,000 tons of goods the author of the scheme considers that it would be possible to pay a dividend of 6 per cent. on bonds and 8½ per cent. on ordinary shares, supposing the capital to be made up of half of one and half of the other.

Our contemporary concludes its account with a description of a scheme of an entirely different character. It has been introduced by a Spanish engineer, F. Gallego Herrera, and it proposes the use of what may be termed a huge, continuous tube of reinforced concrete, which would be submerged, but would have a reserve of buoyancy. A cross section of the proposed tube is given in Fig. 7. It would be oval, measuring 25 m. wide and 18·5 m. high. These dimensions would be sufficient to provide not only for two lines of railway, but also for two roads for motor vehicles, one on either side of the railway lines, each 5·5 m. wide, so that each would accommodate two lines of traffic. These tubes, which would be furnished with fresh and vitiated air channels, and provided with a compartment for ballast and with tubes for drainage, &c., would be anchored to heavy reinforced caissons, sunk to the bed of the sea, and held permanently at a depth of 15 m. below the surface—see Fig. 8.

The use of such a tube would, it is pointed out, permit of the Straits being crossed at a very much narrower point than either of the schemes discussed in the foregoing. It is proposed that the tube should be 15 kilometres in length, and that it should be connected up at each end with an underground line, each 4 kiloms. long and having gradients of 1 in 50. The two places to be connected are Acebuche Point, near Algeciras and Blanca Point near Ceuta. The tube would be built up of seventy-five sections, each 200 m. long, and each and all the tubes would have an excess of buoyancy, even when fully loaded. The anchoring cables would be made of unoxidisable steel, which would be further protected by some preserving material. Each of the anchorages would displace 10,000 cubic metres, and would weigh in water 5500 metric tons. The sections of the tube would be floated out one by one, and as each was got into position it would be jointed up to the sections already laid, with concrete.

The cost of the scheme is estimated at 300 millions of pesetas, an expenditure which the author of it thinks could be amortised by 1950.

World Power Conference.

BRITISH NATIONAL COMMITTEE.

THE following is a list of the papers to be presented at the Second Plenary World Power Conference, which is to be held in Berlin, June 16th to 25th, 1930 :—

SHEET A.—SOLID FUELS.

(1) "The Economic Value of Coal Cleaning in relation to the Problem of Dust and Sulphur Emission from Chimneys," by Dr. Rudolf Lessing. *Authoritative body :* British National Committee.

(2) "The Sale of Coal under Specification," by R. A. Burrows and N. Simpkin. *Authoritative body :* British National Committee.

(3) "The Purchase and Sale of Coke to Specification," by E. C. Evans. *Authoritative body :* The National Federation of Iron and Steel Manufacturers.

(4) "Comparison from the Standpoints of Economics and Practical Working between Compressed Air and Electricity for Use in Collieries," by Professor Douglas Hay and Mr. N. E. Webster. *Authoritative body :* Institution of Mining Engineers.

SHEET B.—LIQUID FUELS.

"Methods of Utilising, for Power Purposes, the Various Petroleum Residuals and By-products." (2) "Economic Aspects of the Future Supplies of Diesel Oil in connection with the Development of Diesel Engines," and (3) "Motor Fuels Produced in the United Kingdom by Low-temperature Carbonisation of Bituminous Coals," by Dr. A. E. Dunstan, J. Kewley, Dr. F. H. Garner, and W. H. Colman, M.I. Min. E. *Authoritative body :* Institution of Petroleum Technologists.

SHEET C.—GASEOUS FUELS.

The following papers have been submitted by the Joint Fuel Committee, which is composed as follows :—Institution of Gas Engineers, Coke Oven Managers' Association, Society of Chemical Industry, Institute of Fuel, Society of British Gas Industries, and Institution of Chemical Engineers.

(1) "The Bearing of Fluctuations in the Price of Coke and By-products on the Cost of Production of Gas," by Michael Barash.

(2) "Mains and Cables in Highways," by Stephen Lacey.

(3) "Comparison between the Different Types of Gas Available for Use in Industrial and Metallurgical Furnaces, with special reference to Calorific Value and Sulphur Content," by H. Clifford Armstrong.

(4) "Methods of Encouraging the Use of Gas in Industry," by E. W. Leask.

(5) "Relative Places of Gas and Electricity in Industrial Heating," by Sir Robert A. Hadfield, Bart., F.R.S., and R. J. Sarjant.

(6) "The Principles of Design, Construction, Operation and Testing of Domestic and Industrial Gas-heating Equipment," by James Wood and Gilbert B. Howarth.

(7) "Producer Gas Practice from the Point of View of the Carbonising Industries and the Utilisation of Low-price Fuels," by N. E. Rambush and Frank S. Townend.

(8) "The Liquor Effluents from the Gas and Coking Industries," by Allen C. Monkhouse.

(9) "The Synthetic Ammonia Industry," by Colonel G. P. Pollitt.

(10) "The Economics and Commercial Development of Low-temperature Carbonisation in Great Britain," by Dr. C. H. Lander.

(11) "The Economics of Benzole Extraction in the Gas Industry," by Harold Hollings.

SHEET D.—STEAM POWER.

(1) "Boilers to Meet Peak Load Conditions and the Application of Heat Storage," by Arthur Spyer. *Authoritative body :* British National Committee.

(2) "Diesel Engines for Peak Load Purposes," by Geoffrey Porter. *Authoritative body :* Diesel Engine Users Association.

(3) "The Treatment of Power Station Flue Gases," by Dr. S. L. Pearce. *Authoritative body :* British National Committee.

(4) "Prospects of Pulverised Coal Firing and Development of Mechanical Stokers on Ships," by Engineer Rear-Admiral Whayman, C.B. *Authoritative body :* British National Committee.

(5) "Further Developments in the Application of High-pressure Steam to Navigation," by the Hon. Sir Charles Parsons, O.M., F.R.S., R. J. Walker, and S. S. Cook, F.R.S. *Authoritative body :* British National Committee.

(6) "The Use in Power Stations of Steam Turbines, having with their Auxiliaries Large Overhead Capacities," by the Hon. Sir Charles Parsons, O.M., F.R.S. *Authoritative body :* British National Committee.

(7) "The Properties of Steam at High Pressure and Temperature," by the late Professor H. L. Callendar, F.R.S. *Authoritative body :* British National Committee.

SHEET E.—INTERNAL COMBUSTION ENGINES.

At the request of the German Organising Committee, reports upon the position of scientific research in this country on the subject of internal combustion engines have been prepared as follows :—

"The Heavy Oil Engine," by A. E. L. Chorlton ; and "The Light Petrol Engine," by H. S. Rowell and H. G. Williams.

The following papers will also be presented :—

(1) "A Review of the General Position of the Marine Oil Engine Industry in Great Britain at the Present Time," by Dr. A. L. Mellanby. *Authoritative body :* British Marine Oil Engine Manufacturers' Association.

(2) "The Trend in Design of Double-acting Two-stroke Oil Engines," by W. S. Burn. *Authoritative body :* The British Marine Oil Engine Manufacturers' Association.

(3) "Characteristics of Spray Nozzles for Internal Combustion Engines," by A. L. Bird. *Authoritative Body :* The British Marine Oil Engine Manufacturers' Association.

(4) "Diesel Auxiliary Generating Machinery," by Harold G. Allen. *Authoritative body :* British Marine Oil Engine Manufacturers' Association.

SHEET F.—WATER POWER.

"Automatic Hydro-electric Stations in Australia," by H. D. Cook. *Authoritative body :* British National Committee.

SHEET G.—MECHANICAL TRANSMISSION OF POWER.

(1) "Power Transmission for Motor Vehicles," by Major Guy Beaumont. *Authoritative body :* Institution of Mechanical Engineers.

(2) "Transmission Gears for Internal Combustion Locomotives," by Alan Chorlton. *Authoritative body :* Institution of Mechanical Engineers.

(3) "Progress in Spur Gear Transmission (The Ground Gear)," by H. F. L. Orcutt. *Authoritative body :* Institution of Mechanical Engineers.

SHEET H.—ELECTRICITY.

At the request of the German Organising Committee, semi-official memoranda have been prepared by the Electricity Commission dealing with the "Rules for Earthing" in force in this country.

These memoranda have been forwarded to Berlin, together with the following documents :—

(*a*) Seventh Annual Report of the Electricity Commissioners.

(*b*) Copies of several statutes.

(*c*) A copy of the Statutory Rules issued by the Home Office giving Regulations applying to places under the purview of the Factories and Workshops Acts.

(*d*) A copy of the Regulations issued by the Mines Department under the Coal Mines Act, 1911.

(*e*) Institution of Electrical Engineers Wiring Regulations.

(*f*) A memorandum concerning the I.E.E. Wiring Regulations prepared by Mr. S. W. Melsom.

(*g*) A copy of the Regulations on Wiring issued by the London County Council.

The following papers will be presented :—

(1) "The British Grid System and its relation to Certain Technical and Economic Problems," by Sir Archibald Page and C. W. Marshall. *Authoritative body :* Central Electricity Board.

Reference has been included in this paper to the following four problems :—

(*a*) "Balancing the Electrical Strength of Electrical Machines, Transformers, Lines and Apparatus, when Working Together ;" (*b*) "Technical and Economic Control of the Flow of Power in Single and Multiple Connected Systems ;" (*c*) "Troubles in Transmission Systems and their Removal ;" and (*d*) "Earthing."

(2) "Modern High-power Switching Stations, Special Consideration being given to Mechanical Design," by R. W. Gregory and F. C. Winfield. *Authoritative body :* Institution of Electrical Engineers.

(3) "Illumination as a Factor in the Sale of Electricity," by C. W. Sully. *Authoritative body :* Electric Lamp Manufacturers' Association.

(4) "Remote Metering," by F. H. Clough. *Authoritative body:* British National Committee.

(5) "The Most Recent Applications of Electricty to Agriculture," by C. A. Cameron Brown. *Authoritative body:* Institution of Electrical Engineers.

(6) "The Economic Operation of Electrified Railways," by Charles H. Merz and Francis Lydall. *Authoritative body:* British National Committee.

SHEET J.—POWER AND LEGISLATION.

"The Extent and Nature of Control by Public Bodies, with reference to the Economic Organisation of Gas Undertakings and the Economic Relations between Consumer and Supplier," by T. P. Ridley. *Authoritative body:* National Gas Council.

SHEET K.—STANDARDISATION.

"The British Standardisation Movement and its Public Significance," by C. le Maistre. *Authoritative body:* British National Committee.

SHEET L.—EDUCATION.

(1) "Training of Engineers in the London County Council Scheme of Technical Education, with special reference to the Instruction in Generation, Transmission and Economics of Power," by G. H. Gater. *Authoritative body:* London County Council.

(2) "The Training of Gas Technicians," by Francis W. Goodenough. *Authoritative body:* Institution of Gas Engineers.

High-pressure Steam for Marine Work.

IN a paper which was read before the North-East Coast Institution of Engineers and Shipbuilders at Newcastle-on-Tyne on Friday of last week, February 7th, Mr. Stanley S. Cook, F.R.S., dealt with the application of high-pressure steam for marine work, and the possibility of obtaining higher efficiencies. He pointed out that, in land installations, recent developments have been made on the basis of the improved efficiencies obtainable by the utilisation of high-pressure steam as apart from higher steam pressures. In the past, the adoption of higher steam pressures for marine work had usually been accompanied by an increase in the maximum steam temperature. In the future, however, any advance would, the author suggested, probably proceed on the lines of recent land practice, and for that reason he wished to emphasise the value and practicability of high pressures as distinct from high temperature. He recalled the putting into service of the high-pressure Clyde river steamer "King George V," which was now, he said, entering upon her fourth year of service. The experience obtained with the installation of high-pressure boilers and turbines on that ship had not revealed any difficulties peculiar to the use of high pressures in boilers, steam pipes or turbines. The operating conditions were admittedly difficult, but the experimental results with a pressure of 550 lb. per square inch and 750 deg. Fah. temperature might be considered, he thought, to have proved conclusively that high steam pressure can be applied safely to practically all classes of vessels. Moreover, the results obtained from this pioneer installation had shown clearly what special precautions ought to be observed. In such installations water-tube boilers were essential, and for their reliable operation purity of feed water was of importance, as was also the complete de-aeration of the feed system. No difficulties had been experienced with condenser tubes, of which four different types had been tested. Good circulation in the boilers by means of downcomer elements was of first importance.

The author then went on to review the application of high pressures which had followed the "King George V.," and stated that there were now built or building mercantile installations of 600,000 total horse-power using water-tube boilers with pressures ranging from 350 lb. to 550 lb. per square inch and steam temperature of 700 deg. Fah. while for naval ships over 650,000 total horse-power, with pressures ranging from 325 lb. to 500 lb. per square inch and steam pressures of 600 deg. to 750 deg. Fah. was in service or under construction. Reference was particularly made to the "Duchess" class of Canadian Pacific liners with 350 lb. pressure and 680 deg. Fah., the Holland-America liner "Statendam" with 400 lb. pressure and 675 deg. Fah., the Italian liner "Ausonia" with 400 lb. pressure and 700 deg. Fah., and the North German Lloyd "Bremen" with 330 lb. pressure. The "Duchess of Bedford," which was commenced in 1928, had made a record in fuel consumption which was 0·625 lb. of oil per S.H.P. hour all purposes, or about 0·57 lb. of oil per S.H.P.-hour for propulsion purposes alone.

In order to make clear the true position with regard to the possible increases in efficiency by increasing (*a*) the superheat only, (*b*) pressure only, (*c*) pressure and temperature with constant superheat, the author had prepared tabular results, which are set forth in Table I.

It was shown that by increasing the pressure from 200 lb. to 600 lb. per square inch, and temperatures from 646·4 deg. to 750 deg. Fah., which gave the same degree of superheat in each case, increased the thermal efficiency by 14·86 per cent., of which 12·23 per cent. is due to increase of pressure and only 2·35 per cent. to increase of temperature. That there should be a greater gain with increased pressure was consistent with the thermo-dynamic principle that the efficiency of a cycle was greater than the higher temperature at which the heat was supplied. For the major portion of the heat was supplied to the steam during the process of evaporation, and the temperature at which this portion of the heat was supplied could only be increased by increasing the pressure. On the other hand, the amount of heat supplied during superheat was a comparatively small proportion of the total, and increase of its temperature had, therefore, less effect in increasing the efficiency.

Tables II. and III., also taken from the paper, give the values of the efficiency of the thermo-dynamic cycle for steam over a range of pressures from 200 lb. to 1000 lb. per square inch (absolute), Table II. for saturated steam and Table III. for steam at a uniform initial temperature of 750 deg. Fah., in both cases with a vacuum of 29in. Hg. (30in. Bar.). These values were calculated from the revised steam properties given by Professor Callendar and published in the "Proceedings" of the Institution of Mechanical Engineers (1929, No. 3). The agreement in thermal efficiency was exceedingly close in spite of the divergences in the values of total heat and specific volume given by different tables.

From the tables given below, it will be seen that an increase of temperature at 200 lb. per square inch by superheating to 750 deg. Fah. increased the efficiency from 31·9 per cent. for the saturated condition to 34 per cent. for the higher initial temperature. Whereas if this increase of temperature was accompanied by an increase of pressure to 1000 lb. per square inch, then the efficiency was increased from 31·9 per cent. to 39·8 per cent., a total improvement of 25 per cent., the greater part of which was due to increased pressure. The figures given represented the thermo-dynamic possibilities with increased pressure. How much the theoretical gain can be realised in practice had yet to be proved. To attain the highest efficiencies, it would be necessary to adopt economical auxiliaries and regenerative feed heating might be utilised with advantage.

TABLE I.

	Press. lbs./sq. in.	Temp. deg. Fah.	B.Th.U. available energy, 29in. vac. (30in. Bar.)	Heat input.	Thermal efficiency.	Increase of Available energy	Increase of Efficiency.
						%	%
Increase of both pressure and temperature. Saturated steam	200	381·8	368·44	1156·2	31·87		
	600	485·4	422·97	1158·0	36·53	14·80	14·62
Increase of pressure with the same initial temperature	200	485·4	392·2	1215·9	32·26		
	600	485·4	422·97	1158·0	36·53	7·84	13·23
Superheat without increase of pressure	200	381·8	368·44	1156·2	31·87		
	200	485·4	392·2	1215·9	32·26	6·45	1·22
With the same superheat	200	646·4	432·6	1301·5	33·24		
	600	750	507·5	1329·2	38·18	17·32	14·86
With the same initial temperature	200	750	460·8	1354·3	34·02		
	600	750	507·5	1329·2	38·18	10·13	12·23
With the same pressure	200	646·4	432·6	1301·5	33·24		
	200	750	460·8	1354·3	34·02	6·52	2·35

TABLE II.—Thermal efficiency at various pressures with saturated steam and vacuum 29in. Hg. (30in. Bar.).

Pressure (lb. per sq. in. absolute)	200	300	400	600	1000
Heat input per lb. (B.Th.U.)	1156·2	1158·3	1160·2	1158·0	1144·6
Available energy per lb. (B.Th.U.)	368·44	389·60	405·03	422·97	438·55
Thermal efficiency, per cent.	31·87	33·63	34·91	36·53	38·32
Increase of efficiency with pressure per cent.	0	5·52	9·54	14·63	20·23

TABLE III.—Thermal efficiency at various pressures with initial steam temperature of 750 deg. Fah. and vacuum 29in. Hg. (30in. Bar.).

Pressure (lb. per sq. in. absolute)	200	300	400	600	1000
Heat input per lb. (B.Th.U.)	1354·3	—	1341·4	1329·2	1303·6
Available energy per lb. (B.Th.U.)	460·8	—	492·3	507·5	519·35
Thermal efficiency, per cent.	34·02	—	36·70	38·18	39·84
Increase of efficiency with pressure per cent.	0	—	7·88	12·23	17·10

HIGH TENSION DISTRIBUTION.

AT a recent informal meeting held at the headquarters of the Institution of Electrical Engineers a discussion on High-tension Distribution was opened by Mr. G. V. Twiss, who remarked that in the past 3-kV and 6-kV lines were constructed as transmission lines, but when 11-kV and 20-kV lines came along the former tended to become distribution lines. Similarly, when 33-kV lines came into existence all lower voltage lines tended to become more in the nature of distribution systems. The new 66-kV and 132-kV lines converted the 33-kV lines mainly into distribution lines. The Central Electricity Board's activities were limited to dealing with a bulk supply at economic prices, thus assisting companies and local authorities to extend their systems. It was essential in rural electrification schemes that the capital should be reduced to a minimum, and as a result overhead distributors were erected wherever possible, whilst in other cases unarmoured cables were laid direct in the ground. Overhead distribution not only reduced the cost of the service, but also enabled faults to be located with ease. The poles could also be used as lamp supports. An interesting technical point was the losses in transformers. On a certain small section of a system there were fifteen transformers with a total capacity of 1300 kVA. The iron losses constituted a 24-hour load, and necessitated the supply of about 60,000 units, whilst the total losses amounted to about 80,000 units per annum. High-tension distribution was closely associated with the electrification of rural and small urban areas, the main requirements being economy consistent with reliability.

SIXTY YEARS AGO.

MANY side issues have been added during the past sixty years to the relationship between capital and labour, but in so far as the principal problem involved is concerned, the subject remains the same, and still awaits a universally acceptable solution. In the early 'seventies there were those who gave anxious thought to the devising of means whereby the almost instinctive antagonism between capital and labour might be converted into a spirit of co-operation and sympathetic understanding on both sides. How little progress has been made in that direction is borne in upon us when we recall that it is scarcely more than yesterday since the Melchett-Turner Conference was discussing the self-same subject. In our issue of February 18th, 1870, we referred in terms of great hopefulness to an experiment designed to promote the establishment of good feeling between capital and labour, which had been begun by Messrs. Fox, Head and Co., of the Newport Rolling Mills, Middlesbrough. Three years previously the firm had come to the conclusion that unionism would ruin the iron trade. It decided to counteract the evil, not by the "clumsy and imperfect" method of establishing or joining an employers' union intended to fight the men's union, but by developing what it believed to be the true relationship which should subsist between a firm and its workpeople. To that end it devised a scheme whereby the men, if they did not belong to a trade union, were to receive out of the firm's profits surplus to 10 per cent. a dividend on their year's wages. For the first two years the trading results left little or nothing for division among the proprietors of the undertaking, and there was no dividend for the workers. During the third year, however, business improved. Capital received its 10 per cent., and there remained over a sum sufficient to pay labour a dividend of 2½ per cent. on its wages. The actual dividends paid out ranged from 6d. to £15, for they were payable even if a man had been only one day in the firm's employment during the year. The total sum distributed came to £750. We attended the distribution ceremony, and from what we saw and learned at it we were led to express the belief that an extension of the scheme to other establishments would lead to trade unionism ceasing to give trouble. Modern experience teaches us that trade unionism is not thus easily to be set at nought. When we wrote in 1870 we were doubtlessly encouraged to overestimate the ability of the scheme to cope with the "evil" of trade unionism by the knowledge that certain union delegates had been signally defeated in an effort to upset it. Several of the firm's men had been persuaded somewhat half-heartedly to leave their allegiance and go over to the union. Their action in this respect became known to the management, and a "black list" of those who had forfeited their right to participate in the dividend was posted in the pay office. The defaulters thereupon petitioned the firm and disowned their connection with the union. At the distribution ceremony Mr. Head announced that the black list had been cancelled. The announcement, we recorded, was received with a storm of applause from about a dozen individuals who tried to look disinterested, and with a "very solemn silence" from the main body of the men. We seem to have had no doubt as to the significance of that solemn silence, but to-day, knowing the intervening history of co-partnership schemes in industry, we wonder whether we fully and correctly interpreted it.

SHIP SURVEYORS.—A competitive examination for two or more appointments as Ship Surveyor under the Board of Trade will held in London on May 7th, 1930. The limits of age are from 25 to 40 years; the salary is from £300 to £500, plus bonus, which is at present £123 on a salary of £300. Applications are to be made, not later than March 21st, on special forms obtainable from Establishment Department (Mercantile Marine Branch), Board of Trade, Great George-street, London, S.W. 1.

INDEX TO BRITISH STANDARD SPECIFICATIONS.—The 1930 editior of the "Index to British Standard Specifications" has just been issued. It is a complete subject index which, in view of the large number—378—of British Standard Specifications now available, some of which include provisions for several articles or materials, will be of much assistance to those purchasing engineering and allied material apparatus and machinery. A numerical list of the specifications is also included. Copies are available from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 1s. 2d., post free.

INSTITUTE OF METALS.—This year's annual May lecture of the Institute of Metals will be delivered by Major F. A. Freeth, F.R.S.—Research Manager, Imperial Chemical Industries, Ltd.—on "The Influence of Technique on Research." The twenty-second Annual General Meeting of the Institute will be held on March 12th to 13th, when fourteen papers will be presented. The annual dinner and dance will take place in the evening of March 12th at the Hotel Victoria. An official visit of members of the Institute of Metals is being paid on February 21st to the British Industries Fair, Castle Bromwich. The members will be entertained to luncheon by the Fair Committee. In September the Institute will visit Southampton for the purpose of holding the Annual Autumn Meeting.

Railway and Road Matters.

THE Dover-street station on the Piccadilly tube railway of the Underground Railways of London is to be removed to a more convenient position at the corner of Green Park, near the Ritz Hotel. The station at Knightsbridge, on the same system, is to be entirely reconstructed and have an entrance in Sloane-street as well as in Brompton-road.

SINCE the paragraph in our Seven-Day Journal page last week as to the appointment of Sir Harold Hartley as vice-president of the London, Midland and Scottish Railway in succession to the late Mr. R. W. Reid, some further particulars of Sir Harold's duties have been issued. The appointment was the result of the recommendations of a special advisory committee appointed by Sir Josiah Stamp, the London, Midland and Scottish president, and an advisory council of eminent scientists is to be set up under Sir Harold's chairmanship.

THE new president of the Institution of Railway Signal Engineers is Mr. W. Wood, the electrical engineer of the Scottish area, London and North-Eastern Railway. In his presidential address on Wednesday, Mr. Wood remarked that the science and art of railway signalling, including telegraph and telephonic communications, had been presented in nearly all its possible aspects—history, education, old practices, present practice, economy possibilities, future developments—on such occasions as that, so he devoted his attention to the general subject of electricity. A most remarkable address followed, which, though highly technical, cannot but benefit the members of an institution who now have to rely so much on the assistance of electricity.

TENDERS have been invited by the Canadian National Railway for the construction of a steel car ferry steamer for service in Northumberland Straits, between Cape Tormentine, N.B., and Port Borden, P.E.I. The ferry has to be completed by July 15th, 1931. The plans call for a vessel with an overall length of 324ft., a moulded breadth of 59ft., a moulded depth of 25ft., a draught under full load of 19ft. 3in., and a dead weight capacity of 1380 tons. It will be equipped with eight boilers, with three triple-expansion engines, developing 8000 I.H.P., two operating the two stern propellers and the other the bow propeller. It will have three tracks on the car deck, with a capacity of sixteen freight cars, or eight passenger cars. The upper deck will accommodate forty motor vehicles.

THE *Railway Newsletter*, an official publication issued from the British Railways Press Bureau, for January states that there are 580 passenger stations within a ten-mile radius of Charing Cross. These are divided up as follows:—Great Western, 22; London and North-Eastern, 98; London, Midland and Scottish, 75; Southern, 200; Metropolitan, 60; and Underground, 125. The statistics of passengers per day are: Paddington, 55,000; King's Cross, 60,000; Liverpool-street, 230,000; Marylebone, 10,500; Euston, 60,000; St. Pancras, 30,000; Fenchurch-street, 50,000; Broad-street, 120,000; Waterloo, 121,000; Victoria, 96,500; London Bridge, 135,000; Charing Cross, 59,000; Cannon-street, 57,000; Holborn and St. Paul's, 44,000; Waterloo and City, 28,000. At Baker-street as many as 637 cars are dealt with in an hour.

IN a paper presented before the Institute of Transport in London on February 10th, Mr. R. H. Wilkinson said that the trolley vehicle has nearly all the advantages of the tram and others in addition, such as:—(1) Ability to pass round an obstruction; (2) higher average speed and increased receipts; (3) the most silent vehicle in public service; (4) low "all-in" costs. It has not the speed of the motor omnibus on the open road; is held up should the supply of electricity be cut off the overhead—an unusual occurrence. It cannot overtake another trolley vehicle, and requires overhead equipment like the tram-car. It is, however, a totally British product, both in construction and during its life, and derives its power from home-produced fuel. It is a valuable load to any electricity supply station and tends to cheapen the whole supply.

AN essential rule in the operation of single lines of railway is that if there is a falling gradient steeper than 1 in 300, there must be an engine in the rear during shunting operations. A local modification of that rule, applicable to Alton Heights Station of the former Caledonian Railway, calls for a brake van to be in the rear of any train and for a guard to be in it, attending to the brake, until the train comes to a stand. On the morning of October 16th last a goods train was backing on the single line at the above-named station, but the guard was on the ground, superintending the shunting, and not in his van. When the train was stopped the coupling between the last wagon and the brake failed, and the van ran away. It was derailed at Lesmahagow, two miles distant, and came to rest foul of the main line. Whilst in that position it was struck by a passenger train, the driver of which overran the signals. In reporting on the incident, Colonel Trench blames the guard of the goods train, the signalman at Alton Heights, and the driver of the passenger train.

ACCORDING to the Board of Trade returns the value of the railway material sent overseas last year was as follows, the corresponding figures for 1927 and 1928 being added in brackets:—Locomotives, £3,275,153 (£3,501,220, £2,286,543); rails, £2,756,167 (£3,427,000, £3,587,628); carriages, £2,418,489 (£2,475,176, £3,113,502); wagons, £2,397,510 (£3,088,735, £3,172,437); wheels and axles, £419,404 (£742,194, £869,764); wheels and axles, £630,829 (£592,383, £728,076); chairs and metal sleepers, £520,274 (£864,778, £1,392,860); miscellaneous permanent way, £1,052,474 (£1,306,456, £1,488,733); total permanent way, £5,546,021 (£7,079,948, £8,318,164). The weight of the rails exported was 326,075 tons (393,667 tons, 429,391 tons), and of the chairs and metal sleepers, 51,773 tons (88,114 tons, 140,453 tons). During the month of December last the value of the locomotives shipped was £303,320, which included:—India, £151,930; South Africa, £45,000; the Argentine, £44,109; Australia, £34,241; other countries in South America than the Argentine, £21,422. The rails sent overseas in December were of the value of £221,355, and included:—South Africa, £58,664; the Argentine, £42,921; Portuguese East Africa, £26,325; New Zealand, £18,892; Straits Settlement, £6817; Australia, £4935.

Notes and Memoranda.

THE electric power transmission system of the Kreuger and Toll Company in the Sundsvaal is being extended by the addition of some 136 kiloms. of new line. The line will work at 70,000 volts. The ten interconnected plants of the company have a total capacity of 60,000 horse-power.

THE new Chrysler building in New York is 1044ft. high, and has involved the use of 21,000 tons of steel in its construction. It is surmounted by a spire 185ft. high, with an 8ft. square base, which was assembled vertically within the building and then hoisted directly into position. Its weight is 27 tons.

A NEW style of publicity device is to be experimented with in Paris. It consists of a thick pane of glass let into the pavement of the streets with a mirror underneath. At night electric lamps shining on the mirror will cause the reflection of an advertisement to appear on the glass, while in bright sunlight a similar effect will be produced.

THE estimates for the new power plant at Seattle, United States of America, show that the 120,000-kVA hydro-electric installation will cost 2,000,000 dollars. Of this amount it is probable that each of the two 60,000 units will cost 700,000 dollars, while the remainder will be expended on the construction and equipment of the power-house.

THE speed of a passenger motor car has not a great deal to do with the disintegration of the types of surfaces considered in a paper contributed to the South African Institution of Engineers by Mr. E. C. Wood, but he says that the speed of heavily loaded vehicles has a great deal to do with it. Experiments conducted by the United States Bureau of Public Roads have shown that a 5-ton lorry travelling at 6 miles per hour and driving over an obstruction 1in. in height, strikes a blow on the road surface of less than one-quarter of that which it strikes at a speed of 10 miles per hour.

SOME extensive experiments have been carried out in the United States for over fifteen years or more on the treatment of growing trees with the object of making them more immune from rot at the ground level when used as telephone poles. These trees were barked to a height of about 5ft., with the exception of a vertical strip about 2in. wide, left to maintain vitality. When felled and used as poles these trees were found to be resistant to rot, on account of their encasement with rosin, except for the narrow strip that was unbarked, which was liable to the attack of fungus. A notice of these tests is given in the *Telephone Engineer* of January.

A SNOW fence of wire and burlap sacks was erected to prevent the blocking of a highway near Warsaw, Ind., by drifts during recent heavy snowstorms. Two wires 3ft. apart, with the lower one near the ground, were strung on steel posts, 100ft. back from the road for a distance of about 1100ft., and hundreds of sacks were attached to these by hog rings, open spaces being left between the sacks. This fence checked the wind, so that the snow formed a drift behind the fence instead of being carried over into the road. The posts were those carried in stock by the highway department for road signs, and the sacks accumulated last summer when calcium chloride was used on the roads to prevent dust. The wire was purchased.

THE colour of aluminium paint may be altered by incorporating small amounts of suitable tinting pigments, but the metallic lustre of the aluminium is usually retained. The addition of material quantities of granular pigments interferes with the formation of the coating of aluminium flakes, and thereby deceases its effectiveness as a barrier against the movement of moisture. The best way to use aluminium paints for making material proof against moisture and yet obtain the colour and sheen of ordinary paints and enamels is to apply two coats of plain aluminium paint followed by one or two coats of a paint or enamel that will produce the desired appearance. Aluminium paints prepared in the way described afford, says the *Contract Record*, a satisfactory foundation for the application of customary finishes.

IN the course of an extensive investigation on the influence of additional elements on the physical properties of nickel-iron alloys, P. Chevenard has studied the influence of aluminium; data are presented on an alloy containing a nickel 60 per cent., chromium 10 per cent., aluminium 5 per cent., iron remainder. The resulting alloys constitute an aggregate of two phases, the mutual solubility of which increases with rise of temperature. Such alloys, comparable with duralumin, are susceptible to structural modification and hardening on quenching and tempering. The present study shows that very appreciable degrees of hardening are obtainable by means of heat-treatment in the reversible ferro-nickels containing aluminium; the method furnishes a simple means of still further enhancing the mechanical properties of a series of alloys possessing highly valuable physical and chemical qualities.

IN the course of a paper on the testing of building materials read before the Belfast Association of Engineers, Professor F. H. Hummel said that a good concrete of twenty-eight days may carry as much as 4 tons per square inch; a 6in. by 6in. specimen will therefore require a load of about 150 tons. To cover exceptional cases, such as some of the natural rocks, and to have a reserve of power, a testing machine for this class of work should have a capacity of 250 tons. A universal testing machine of this size is out of the question in most laboratories on the score of initial cost and large dimensions. A hydraulic press is a cheap, reliable, and convenient form of testing machine for the purpose. The load applied by this type of machine is usually determined by the product of the pressure gauge reading and the area of the ram. This, however, is not accurate enough for comparison with results obtained by a machine of the lever type, and the author has calibrated the press in his laboratory by using a standard steel bar and an extensometer, the stress-strain relation of the bar having been determined in a large lever machine at the City and Guilds College in London. The calibration can be readily repeated and eliminates pressure gauge errors and cup leather friction at the same time.

Miscellanea.

THE city of Vancouver proposes to construct a civic hydro-electric plant on the Cheakamus river.

A BORE-HOLE is being put down in the Upper Langdale Valley, Westmorland, with the object of prospecting for iron ore.

DURING last year Canada produced 2,728,627 tons of newsprint, representing an increase of about 15 per cent. over 1928.

THE Hackney Corporation is extending its electricity plant with Parsons turbo-generators and Reyrolle switch-gear at a cost of £200,900.

A GASHOLDER of 3,000,000 cubic feet capacity is to be built at the Howden-on-Tyne works of the Newcastle and Gateshead Gas Company by the Furness Shipbuilding Company.

ACCORDING to news from Morocco, the mines of Bon Arfa will be in a position to deliver 100,000 tons of manganese ore to France as soon as the railway to the coast is completed.

PATENT rights have been granted in the United States for a glycerine anti-freeze compound, consisting of water, glycerine and glucose, the ingredients being in substantially equal proportions by weight.

THE Minister of Health has appointed Mr. C. Bride, M.A., B.Sc., A.I.C., to be an Inspector under the Alkali, &c., Works Regulation Act, 1906. He has been assigned to the district with headquarters in London.

AN excavator with a bucket of 15 cubic yards capacity has recently been put in commission at Duquoin, Ill., U.S.A. It is electrically driven, is capable of dumping soil 85ft. above base level, and weighs in all 1600 tons.

IT is reported that a vein of copper ore has been found in Lord Leconfield's iron mine at Cleator Moor. It is not thought likely, however, that there will be any appreciable quantity. Copper has frequently been found in the vicinity.

IT is reported from Stockholm that the Midnaes Nya Traevaruaktiebolag will be ready in a few weeks to start its new mill for the manufacture of an insulating wall-board called "Jonite." The annual capacity of the mill will at first be about 1000 tons.

IT is estimated that 292,000,000 dollars will be required to complete the hydro-electric undertakings planned for the next three years in Canada. Over 378,000 horse-power was placed in operation during last year, making the total for the country 5,727,600 horse-power.

THE papermaking plant of the International Paper Company at Dalhousie, New Brunswick, which has just been opened, has been arranged for an ultimate production of 550 tons a day; but it is being started with two units having a combined capacity of 275 tons a day.

THE Manchester Corporation has decided to consult Dr. Pearce, of the London Power Company, Mr. J. Rider, of Preece, Cardew and Rider, and Mr. Melling, of Melling and Arden, as to the possible means of removing sulphur fumes from the flue gases of its power stations.

WESTERN COLORADO is, says the *Engineering News-Record*, threatened with serious shortage of water in 1930 on account of unusually light snowfall this winter. Unless heavy snowstorms occur during the next few months it is predicted that irrigation and water power facilities will be badly impaired next summer and autumn. Snow lies less than a foot deep at altitudes of more than 10,000ft. Usually these places are heavily banked early in November.

TECHNICAL Paper No. 1 on Water Pollution Research, Department of Scientific and Industrial Research, London, which has just been issued by H.M. Stationery Office, 6d. net, deals with water softening, the base-exchange or zeolite process, and gives a summary of existing knowledge on this subject. The report has been prepared by Dr. A. R. Martin under the direction of Professor G. T. Morgan, in the Department's Chemical Research Laboratory at Teddington.

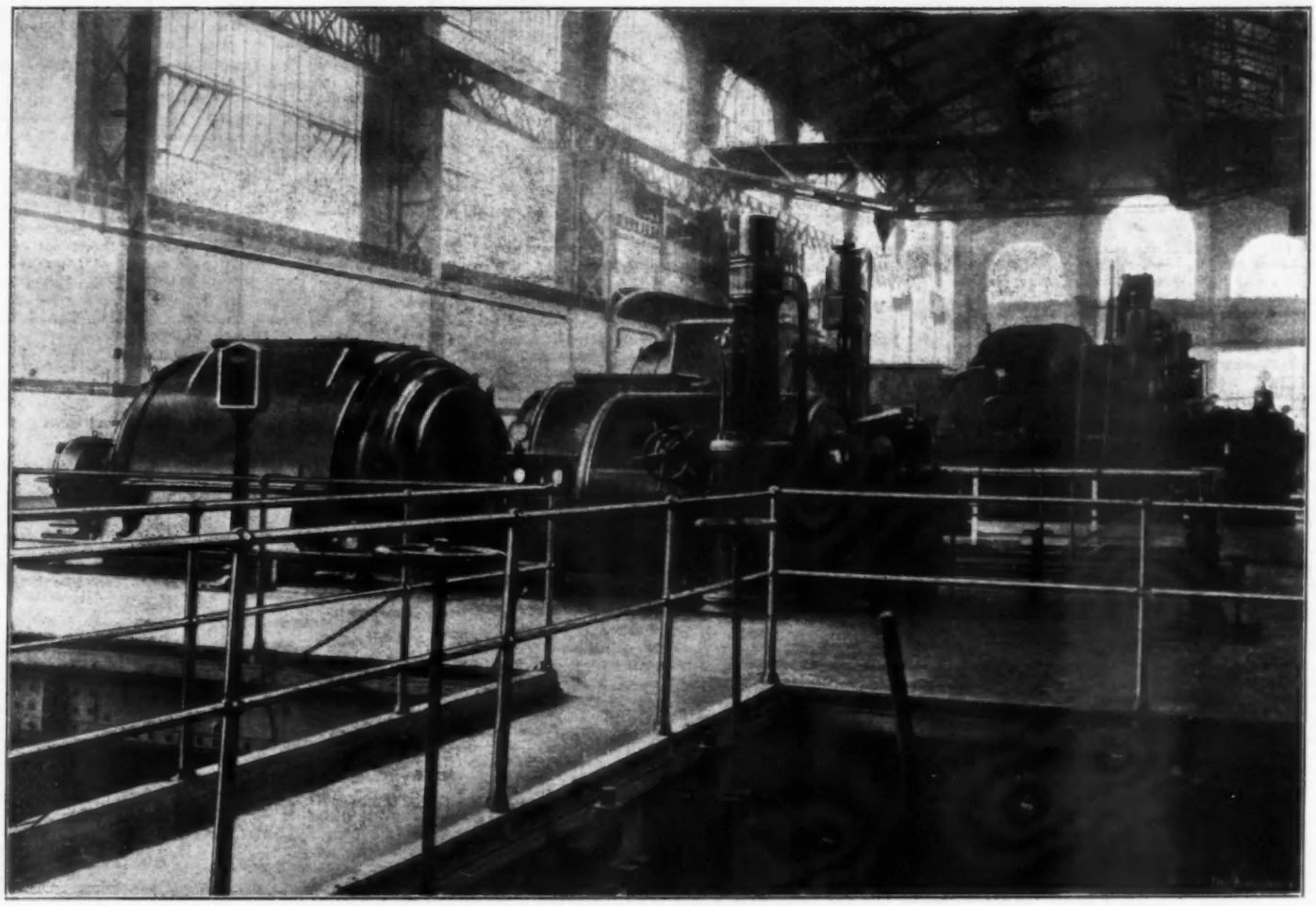
THE Council of the Institution of Naval Architects has awarded the Gold Medal for the year 1929 to Mr. John Johnson, chief superintendent engineer of the Canadian Pacific Steamship Line, for his paper "The Propulsion of Ships by Modern Steam Machinery," and the Premium to Lieut.-Colonel F. Dondona, for his paper "Sea Trials of Italian Destroyers." The Medal and the Premium will be presented at the opening of the annual general meeting, which will be held on April 9th at the Royal Society of Arts, John-street, W.C. 2.

AN interesting electric steam boiler installation has just been completed in what is reputed to be the world's largest poultry farm at Corstorphine, Edinburgh. Its size may be gauged from the fact that as many as 170,000 eggs are hatched and the pullets reared up to six weeks of age in a mammoth incubator and brooder at one time. Steam heating is essential for this delicate work, and the system of steam supply has been arranged by Commander Campbell Allen, of Messrs. Bastian and Allen, Slough. Three "Mascarini" boilers, working on a load of up to 900 kW on 400 volts, three-phase supply, are used, in conjunction with a Ruths steam accumulator.

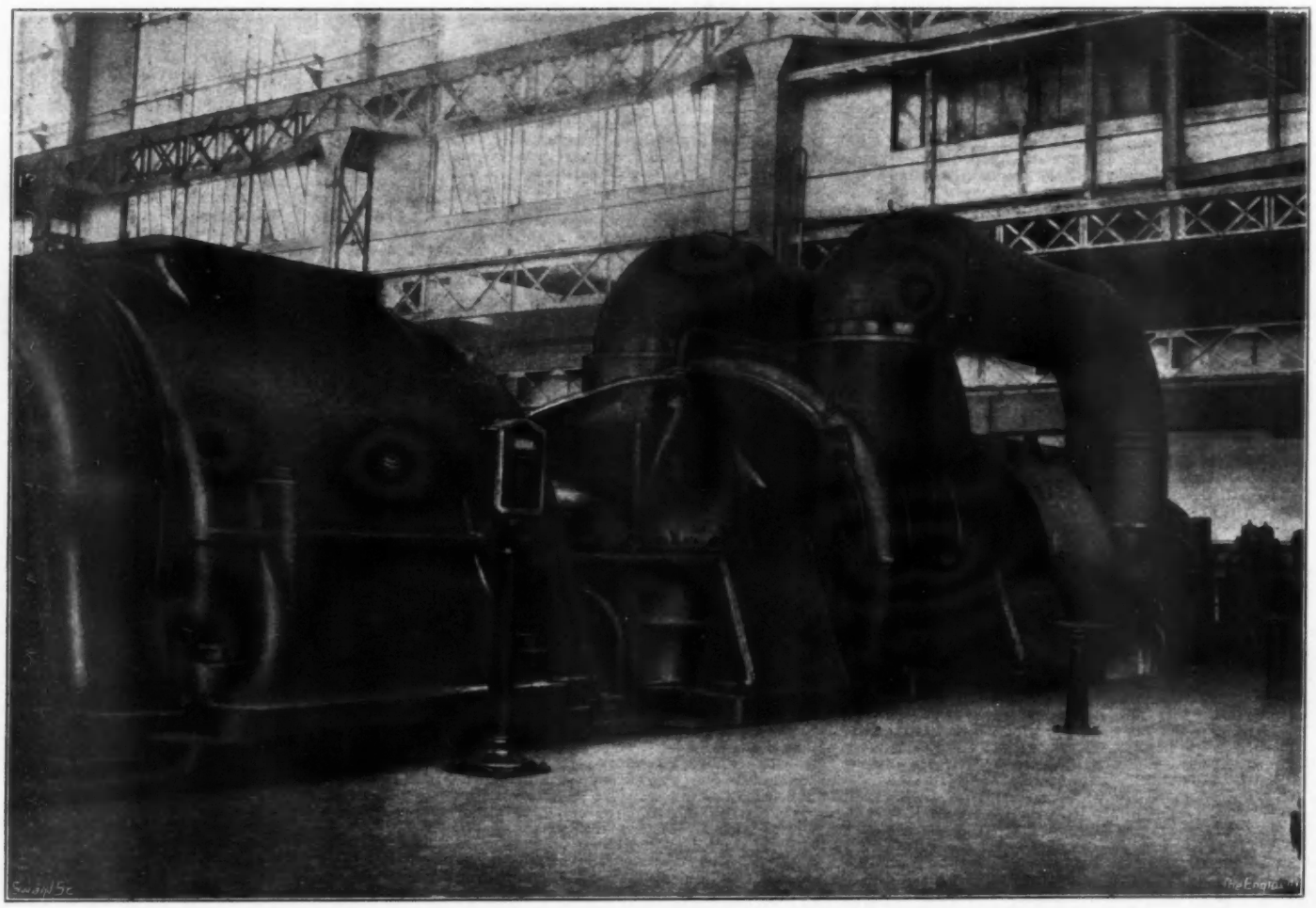
THE intention of the Ontario Government to aid in building up an iron ore industry in Northern Ontario was reiterated by Premier G. Howard Ferguson in addressing the Canadian Manufacturers' Association at Toronto. Legislation will be introduced at the coming season of the Legislature to provide for the payment of 1 cent per unit on all iron ore mined in the province. "No other place in the world has such extensive deposits of low grade ore as we have," he stated. "The problem is to eliminate the deleterious substances which prevent us from using it. The Ontario Research Foundation is studying, experimenting and trying to find a process to overcome this defect. We see something in 'sponge iron,' and we propose to carry this ore from Northern Ontario, build a blast-furnace in the laboratory, and carry on the experiments with our own experts. I feel confident that we are on the verge of founding a marvellous metal industry in the province."

ISSY-LES-MOULINEAUX POWER STATION

(*For description see page* 178).



11,200-kW HIGH-PRESSURE AND 35,000-kW LOW-PRESSURE TURBINES WORKING IN SERIES



35,000-kW HIGH-PRESSURE TURBO-GENERATOR

The Engineer
Annual Subscription Rates

(Including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES	£3	5	0	
CANADA	£3	3	0	Thick Paper edition.
	£2	18	6	Thin Paper edition.
ABROAD	£3	7	6	Thick Paper edition.
(except Canada)	£3	3	0	Thin Paper edition.

AFRICA	Central News Agency. All Branches	
* £3 7s. 6d.	CAPE TOWN : Wm. Dawson and Sons, Ltd.,	
† £3 3s. 0d.	29–31, Long-street (Box 489)	
	JOHANNESBURG : C. Juta and Co.	
ARGENTINE	BUENOS AIRES : Mitchell's Book Store, 576,	
* £3 7s. 6d.	Cangallo	
† £3 3s. 0d.		
AUSTRALIA	Gordon and Gotch (Australasia), Ltd. All	
* £3 7s. 6d.	Branches	
† £3 3s. 0d.	MELBOURNE : Robertson and Mullens,	
	Elizabeth-street	
BELGIUM	BRUXELLES : W. H. Smith and Son, 78–80,	
* Fr. 590	Rue du Marché-aux-Herbes	
† Fr. 550		
CANADA	American News Company, Ltd. All Branches	
* $15·25	MONTREAL : Gordon and Gotch, Ltd., 334,	
† $14·25	Notre Dame-street, W.	
	TORONTO : Wm. Dawson and Sons, Ltd., 87,	
	Queen-street East	
	TORONTO : Gordon and Gotch, Ltd., 81,	
	Queen-street West	
CEYLON	COLOMBO : Wijayartna and Co.	
* Rs. 44·5		
† Rs. 41·5		
CHINA	HONG KONG : Kelly and Walsh, Ltd.	
* $37	SHANGHAI : Kelly and Walsh, Ltd.	
† $34·5		
EGYPT	CAIRO : Express Book and Stationery Store,	
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi	
† £3 3s. 0d. (Pt. 308)		
FINLAND	HELSINGFORS : Akademiska Bokhandeln,	
* M. 650	Alexandersgatan, 7	
† M. 605		
FRANCE	PARIS : Boyveau and Chevillet, Rue de la	
* Fr. 418	Banque, 22	
† Fr. 390	PARIS : Berger Leverault, 229, Bld. St.	
	Germain	
	PARIS : Brentano's, 37, Av. de l'Opera	
	PARIS : Dunod, 92, Rue Bonaparte	
	PARIS : W. H. Smith and Son, 248, Rue de	
	Rivoli	
GERMANY	BERLIN–LICHTERFELDE–WEST : H. Her-	
* R. mks. 70·00	manns, Dahlemer Strasse 64 A	
† R. mks. 65·00	WESTERN GERMANY : Fritz Rehfus, Blumen-	
	thalstrasse 10, Cologne	
	LEIPZIG : K. W. Hiersemann, Konigstrasse 29	
HOLLAND	ROTTERDAM : Hector's Boekhandel, Noord-	
* Fl. 41·00	blaak 59	
† Fl. 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C,"	
	Gelderschestraat 4	
INDIA	BOMBAY : Thacker and Co., Ltd.	
* Rs. 45	CALCUTTA : Thacker, Spink and Co.	
† Rs. 42		
ITALY	MILAN : Ulrico Hoepli	
* Lire 300	ROME : Maglioni and Strini, 307, Corso	
† Lire 280	ROME : Fratelli Treves, Corso Umberto I, 174	
	ROME : Fratelli Bocca	
	TURIN : Rosenberg and Sellier, v. Maria	
	Vittoria 18, and their Branches at Naples	
	and Rome	
JAPAN	Maruzen Co. All Branches	
* £3 7s. 6d.		
† £3 3s. 0d.		
JAMAICA	KINGSTON : Educational Supply Co.	
* £3 7s. 6d.		
† £3 3s. 0d.		
NEW ZEALAND	AUCKLAND : Whitcombe and Tombs, Ltd.	
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches	
† £3 3s. 0d.	NAPIER : J. Wilson Craig and Co.	
RUSSIA	LENINGRAD : Mezhdunarodnaya Kniga, Pros-	
* £3 7s. 6d.	pect Volodarsky, 53 A	
† £3 3s. 0d.	MOSCOW : "Litisdat," Koumetsky Most, 5-15	
STRAITS SETTLEMENTS	SINGAPORE : Kelly and Walsh,	
* $29·25	Ltd.	
† $27·25		
SWEDEN	STOCKHOLM : A/B Wennergrens Journal-	
* Kr. 61·00	expedition, Stockholm 1	
† Kr. 57·00	STOCKHOLM : A/B C. E. Fritzes Kungl.,	
	Hofbokhandel, Fredsgatan, 2	
SWITZERLAND	BERNE : Joh. William De Groot, Laupenstr. 5	
* Fr. 85·20	ZURICH : Rosa Leibowics, 4, Ankerstr.	
† Fr. 79·50		
UNITED STATES OF AMERICA	International News Co., 131, Varick-street, New York, N.Y., and all Branches	
* $16·40	Entered as second-class matter at the Post Office,	
† $15·25	New York, N.Y. December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)	

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 2d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch —minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. Temple Bar 2256, 2257.

By arrangement with Reuter's Engineering Service, the Engineer contains the latest news from all parts of the world which is likely to be of interest to engineers.

Contents.

THE ENGINEER, February 14th, 1930.	PAGE
A SEVEN-DAY JOURNAL	177
HIGH-PRESSURE EXTENSIONS AT THE ISSY-LES-MOULINEAUX POWER STATION. (Illus.)	178
ATMOSPHERIC POLLUTION IN 1928–1929	180
OBITUARY—Sir William Hoy—Henry Holgate—Sir John Espley	182
LETTERS TO THE EDITOR—	
Fundamental Principles of Measurement	182
Can Economics be Made an Exact Science	183
SOUTH AFRICAN ENGINEERING NOTES	183
PROJECTS FOR TUNNELLING THE STRAITS OF GIBRALTAR. (Illus.)	184
WORLD POWER CONFERENCE—LIST OF BRITISH PAPERS	185
HIGH-PRESSURE STEAM FOR MARINE WORK	186
HIGH-TENSION DISTRIBUTION	186
SIXTY YEARS AGO	186
RAILWAY AND ROAD MATTERS	187
NOTES AND MEMORANDA	187
MISCELLANEA	187
LEADING ARTICLES—	
Humanising Industry	189
Scientific Research on the Railways	190
THE WORLD ENGINEERING CONGRESS IN JAPAN.—No. IX.	190
LITERATURE	191
BOOKS RECEIVED	191
RE-BORING MACHINE FOR MOTOR CAR CYLINDERS. (Illus.)	192
CANADIAN ENGINEERING NEWS	193
TURBINE BLADE CORROSION	193
GENERAL OPERATION EXPERIENCES WITH THE FIRST "WOOD" STEAM GENERATOR. (Illus.)	194
2100-TON SLIPWAY AT ARUBA, DUTCH WEST INDIES. (Illus.)	196
CONTRACTS	197
CALENDARS, DIARIES, &c.	197
PROVINCIAL LETTERS—	
The Midlands and Staffordshire—Lancashire	197
Sheffield—North of England	198
Scotland—Wales and Adjoining Counties	199
PERSONAL AND BUSINESS ANNOUNCEMENTS	199
CURRENT PRICES FOR METALS AND FUELS	200
FRENCH ENGINEERING NOTES	201
BRITISH PATENT SPECIFICATIONS. (Illus.)	201
FORTHCOMING ENGAGEMENTS	202

EIGHT-PAGE SUPPLEMENT—THE BRITISH INDUSTRIES FAIR.

NOTICES TO READERS.

With this number of THE ENGINEER *there is issued a Special Supplement entitled "The British Industries Fair at Birmingham."*

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through which the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

THE ENGINEER.

FEBRUARY 14, 1930.

Humanising Industry.

AT the banquet of the Liverpool Engineering Society on Thursday, February 6th, several notable speeches were delivered. The guest of the evening was Lord Wester Wemyss, President of the Institution of Naval Architects. In proposing "Merseyside," he spoke with gravity upon the Naval Conference. Everyone desired that it should attain the goal at which it aimed, but "he had seen it stated that the Conference could only be a success if it was unanimous. If to gain unanimity, they [Great Britain] gave away one inch of their power, it would not be a success. If to gain unanimity they even ran the risk of leaving themselves in a weaker position, then again it would not be a success. . . . Without sea power England would not only fall to a third-rate position, but would even be in danger of disappearing." The Lord Mayor of Liverpool, Mr. Lawrence D. Holt, responded to this toast. The people of this country, he said, were "absolutely dependent upon the sea for their living, and they recognised the paramount necessity of the efficiency and eternal vigilance of the British Navy. Whether it was small or great must be left to necessity, and to some extent to expediency, but so far as the quality was concerned they devoutly prayed and confidently trusted that it would ever be maintained at the very highest pitch of perfection." It is not necessary to say that a Liverpool audience received these speeches with applause. It is in such centres, and there are many of them round our coasts, whose intimacy with the sea far transcends that of inland towns and even of the Metropolis—great port though it is—that the Royal Navy loses the academic flavour with which politicians invest it, and is seen as an absolute necessity to the free circulation of the life-blood of the nation—its maritime trade.

Whilst it is the earnest hope of all who recognise realities, and are not seduced by abstractions, that the prestige and long-wielded influence for good of the British Navy may be in no way diminished by the decisions of the Naval Conference, and that it may continue to give that support to overseas trade which is amongst its greatest peaceful duties now as it has been for three hundred years, yet our chief anxiety at the present time is the recovery of our industries from the maladies which are afflicting them. Anything that may be said upon this subject by great leaders of commerce must be heard with attention. They, indeed, are more likely to know the seat of the trouble, and, possibly, are better able to suggest a cure, than professional economists. Their daily contact with the problems endues them with an instinct which is more valuable, more trustworthy in the long run, than the data and statistics of the students. We listened, therefore, with the greatest interest to a few comments upon the position with which Mr. Holt concluded his speech. He spoke of the danger of centralisation which, if carried to extremes "undermined all the life at the circumference," and destroyed that independence of character which "goes to make up local patriotism and local effort." He referred to their great ancestors and predecessors, who "threw their humanity into industry," and he prescribed as a cure for present ills "that they should seek again to re-humanise that great social and industrial organisation of which they were the joint inheritors." That was very well said. It touched a common chord in all our hearts. The increasing practice in all branches of industry is to obliterate the individual. The "central office" is all in all. In the detective literature of the day the "organisation" is a familiar factor. It is run, generally for malign purposes, by some master villain who remains a mysterious abstraction—invested with terrible powers—to the subordinates whom he forces to do his will. Their own individuality is absolutely submerged in him; they work, and work only, for the "organisation." With the sole difference that the object is a beneficent one, the condition is not dissimilar from that which obtains in many of the vast industries which now exist under centralised control. We are asked to believe that modern conditions necessitate the existence of such organisations; that without them industry cannot be successfully pursued; that without them necessary economies cannot be effected, and cut-throat competition be arrested. That is, no doubt, in part, true; but there are many wise men, men of importance in the country, who see with misgiving the course which developments are taking. There is, in fact, a kind of club which devotes itself to the encouragement of individuality. A recent energetic letter written by Sir Ernest Benn, who is, we believe, a member of that club, will be recalled by some of our readers. It is, indeed, easy to say a great deal in support of individualism, and thereby of small organisations as opposed to great ones, and easy to indicate the ills of a system which submerges all but a few personalities. An oft-quoted and effective example is presented by the grouping of railways. In the old days when there were many companies there were many locomotive superintendents, and the young engineer had something to aim at. He might rise to the highest position in his own company. Now there are only four such posts, and even they do not carry the old powers. There are not the same openings for the ambitious youth. Where many might have got to the top, now all but four must be content with subordinate positions. Then, again, not only in railways, but in practically all great businesses, the personal touch that existed between the managers of departments and their clients is declining, if it has not already gone. The managers are not allowed to act on their own discretion; everything must be referred to that abstraction—the central office.

These things must be, perhaps, but it is well that we should recognise their defects. Centralisation or rationalisation, or whatever we may choose to call it, may be an absolute necessity, but it is not without its drawbacks, and we shall do well to take to heart Mr. Holt's advice to re-humanise industry. It means so much to everyone of us to feel that we are something more than a mere cog in a machine. There is no man who is not the better, the happier, the more contented, and hence the better servant, if he is allowed to exercise his own individuality. Socialism denies him this right, and Socialism is only rationalisation carried to its logical conclusion. Wise employers know it well enough. Amongst many distractions, they do endeavour to maintain a personal touch with their people. They try to make their men feel that the personal effort of each of them counts for something in the success of all. The bigger a business grows, the more difficult that becomes; but everyone who has a touch of human sympathy left under the stress of industrial economics is aware of its value. We need a contented population, and one direction in which it is to be sought is

by giving every man the opportunity to express in some measure his own personality. Many will not desire to take it, but, on the other hand, many more will. They do not want to be no more than parts of a mechanism. They want to remain human beings. How that end is to be completely reached, whilst retaining the economic advantages of rationalisation, is one of the problems of modern industry.

Scientific Research on the Railways.

THE railways of Great Britain have a created capital of 1211 million pounds, of which 882 millions have been expended on what may be called the way and works, 156 millions on rolling stock, 23 millions on manufacturing and repairing plant, 9 millions on steamboats, 8 millions on canals, 64 millions on docks and harbours, 10 millions on hotels and 7 millions on electrical power stations. The receipts are 218 millions a year—of which 194 millions come from railway business purely; the expenditure is 177 millions —of which 153½ millions are on the railway. After adding 7 millions for miscellaneous receipts, such as rents, to the balance of 41 millions and deducting 3 millions for miscellaneous charges, there remains a balance of 45 millions to be paid out in interest and dividends, or 3·84 per cent. on the total capital receipts. The railways employ about 700,000 persons, pay away 7 millions a year in rates and nearly 1½ millions a year in national insurance; their locomotives consume 13 million tons of coal and require 36 million pints of lubricating oil. These statistics will give some idea of the enormous size of the business carried on by British railway companies, which, judged by receipts, is four times as great as that of the Post Office. We mention these figures as they have no small bearing on the appointment of Sir Harold Hartley to the position of vice-president of the London, Midland and Scottish Railway, which office is to carry, in addition to the duties for which the late Mr. R. W. Reid was responsible, that of Director of Scientific Research.

In this connection it must be borne in mind that Sir Josiah Stamp, the president of the L.M. & S. Ry., devoted a considerable portion of his presidential address at the Institute of Transport on October 14th last to the question of what he called railway research. That address was the subject of a leading article in THE ENGINEER of the following Friday, the 18th, and much that could be said now, as a result of the present interesting appointment, was said then. It would, however, appear desirable to repeat that collective experiment and collective testing were considered to have made considerable headway, but collective research had gone less far. Further, the great defect of individual research departments' work was that the history of failures or negative results—which was so valuable—was completely lost. There was also an enormous waste in duplication of effort and, in general, not a large enough view. As examples of direction in which research could be applied to questions affecting railway companies Sir Josiah quoted, as regards steamers, the question of motive power and fuel—now in a state of flux—with the range of applicability of high-pressure systems; the handling appliances in docks; the design of motors and the net costliness of road maintenance in respect of roads; whilst for railways there was the range of electrification and the question of locomotive types and high-pressure boilers, wagon capacity, braking and lubrication. If, as may be anticipated, the appointment of Sir Harold Hartley is a sequel to Sir Josiah's address, it may be noted that Sir Josiah on the occasion in question proceeded to say that for the non-physical subjects in all types of service the railways needed to know much more about the unit cost of operations and the limit of profitable expenditure on particular services, the economic life of repairable assets and the incidence of sickness and fatigue in the labour ranks. If to all this we may take the liberty of adding a few subjects which occur to us as suitable for investigation in connection with railway operation, we would name the provision of big yards on the outskirts of all large cities which the incoming trains of all the companies serving that particular city could enter. There the trains should be broken up and the wagons sorted for the various depôts and conveyed thence in trips at such intervals as would keep the depôt supplied. The outgoing wagons, when loaded, would be similarly worked from the depôt to the yard and there placed in sidings allocated to the various destinations, out of which sidings complete trains would be taken. That would not only greatly reduce the size of costly terminals, but eliminate a deal of the present congestion. Another question which might be considered is the disposal of the carriages of business trains between their arrival in town in the morning and departure in the late afternoon. We remember Mr. Dugald Drummond drawing attention to the fact that the London and South-Western trains, after arrival at Waterloo, had to be taken to Wimbledon to be stabled, and we may instance the large amount of rolling stock that is locked up by certain trains being kept intact from their arrival at destinations in the evening or early morning until required for the corresponding outward journey twelve or so hours later. Another point that might be investigated is the use of steam rail motors. If these are the success that their use on the London and North-Eastern implies, why are they not employed on the Great Western and the Southern? Cannot the objection that provision must be made for a possible unexpectedly larger number of passengers than usual be met?

There are three points we would mention in conclusion. The first is that it must be remembered that Sir Harold Hartley is in the happy position of being vice-president for works and ancillary undertakings. He therefore has charge of every department, except the operating, wherein his investigations will have to be made. The second point is more in the nature of a query. It is, is Sir Harold to work solely for the benefit of the London, Midland and Scottish, or are the other companies to benefit from his labours? Since the latter are bound to follow in any new departure that may result from the research work now to be undertaken, the intention may be—and we hope it is—that whilst Sir Harold is more immediately associated with the L.M. and S., all the companies are to share in the results of his investigations. The third point we make is to draw attention to the remarks made last Friday by Mr. Garcke at the luncheon of the British Electrical and Allied Industries Research Association. He said that research work on insulating oils had cost £8500, but was saving £100,000 a year; researches on the heating of buried cables had cost £18,500, but had saved the industry at least a quarter of a million and had added something like four millions to the duration value of the cables. When such figures are considered, who knows how valuable may be the results achieved by the locomotive testing plant which, there are good grounds for believing, is to be set up by the railways in conjunction with the Department for Scientific and Industrial Research?

The World Engineering Congress in Japan.

(By Our Special Representative.)

No. IX.*

ABSTRACTS OF PAPERS (*continued*).

CEMENT mixing is a very important matter for the builder, and it is one to which the Japanese are giving very close attention. In the past the poor quality of cement was notorious, and the most spectacular disaster in the earthquake of 1923 in Tokio was the collapse of a huge building, with the loss of 180 lives, as it was nearing completion in Marunouchi. The first shock brought this building down, and the bad quality of cement used had been noted by observers in the adjoining buildings, none of which were seriously affected by the continued shocks of that terrible day and the days that followed.

An Investigation of Abrasion in Cements and Mortars is the title of a paper by Mr. S. Uchida, Assistant Professor of Tohoku Imperial University, who has carried out a series of extensive experiments, and presents the following conclusions:—

That observation of the relative degree of abrasion of cement and mortars with abrasion-testing apparatus is a satisfactory and convenient method of measuring resistance to abrasion.

That different compositions of cement produce neat cement and mortars of different abrasion quality.

That aluminous cement will have the same resistance to abrasion at two days that Portland cement will have at fourteen days.

That a suitable quantity of mixing water is absolutely necessary to produce cement and mortar which will have a high resistance to abrasion. Especially is it needed for aluminous cement, as already noted. The use of an excessive quantity of water will reduce resistance to abrasion of cement and mortars in about the same proportion as it will reduce the strength.

That the relation of the abrasion and the age of cement and mortars may be expressed as about the same as the relation between age and strength.

That proper curing is absolutely necessary to produce cement and mortar which will have a high resistance to abrasion. Water-cured specimens will reduce resistance to abrasion of all cement and mortars.

That the increase of load which acts upon the specimen will increase the extent of abrasion.

That the replacement of some parts of the Portland cement with admixtures will affect the resistance to abrasion of cements and mortars.

That Portland cement mortars have a higher resistance to abrasion than neat cement.

That mortars of coarse sand have a lower resistance to abrasion compared with mortars of fine sand.

Oil mining is one of the newer industries that make increasing demands upon the engineer and the chemist. Great waste has marked its development, chiefly in the United States, but in the last seven or eight years probably more progress has been made than in all previous years in those things essential to the prosperous conduct of the industry. Such is the conclusion of the author of the paper *Mechanical Problems in the Petroleum Industry* (C. W. Nofsinger), who surveys the history of refining and cracking, and discusses the methods used, which are continually undergoing change. The art of cracking heavy petroleum to produce lighter hydrocarbons, we are told, was invented by Silliman in 1855. "A few years later, it is reported, a stillman left his shell still for a few hours, pressure built up, and it was found that a greater yield of high materials was obtained, and thus, it is said, cracking was discovered." It seems evident from the statements quoted that our knowledge regarding the beginnings of the great petroleum industry is as yet none too sure.

Of course, it was the enormously increased demand for petrol that caused the industry to depart from its original primitive state—supplying our oil lamps forty years ago, for example—and to-day it demands all the aid that science and skill can give to improve processes of production and refinement.

The layman mostly thinks of separators in connection with the dairy, but science has spread the use of the idea embodied in this machine until it is of service to other industries. The increasing sphere of the work of the centrifugal separator is the subject of a paper, *The Development of Separator Technics*, by E. A. Forsberg, chief engineer of the Aktiebolaget Separator, Stockholm. Great advances have been made on the old forms of purification by gravity, &c., and the truest economies have been effected by making marketable oils and fats formerly thrown away. The paper discusses the mechanical and technical merits and drawbacks of various purification systems that have been tried out, or may still be in use, and demonstrates how separate industries have been benefited, including dry cleaning, petroleum, whale-oil, vegetable oils, dyes, colours and varnishes, and the wool industry, in the recovery of wool fat. But much remains to be done—"From the preceding," he sums up, "it will be seen that an intense work is going on for utilising separators in a large number of widely different spheres of labour. The separator, which was first produced merely for the particular purpose of skimming milk, and which already in that sphere has given rise to a vast industry, is now about to exceed the original limits of its use, and to penetrate one sphere of work after the other. We are at present only at the beginning of this development, and it is as yet impossible to predict whither it will lead. But this much is certain, that here we have a vast field for scientific engineering work, and I have, therefore, believed myself justified on an occasion like this to make a few statements concerning the work that has hitherto been done, and also to hint at future lines of development."

A most enlightening paper on the *Housing Conditions in the United States* tends to show that the Old Adam in man is not removed even when he moves to the New World, and enjoys material benefits denied to those living in older civilisations, where life is handicapped at every turn. The paper is by Lawrence Veiller, secretary-director of the Housing Association of the United States of America, a society that is doing valuable work in drawing attention to the inadequate housing conditions that exist.

After a survey of the extraordinarily complex character of the population of the great cities, the author itemises the variety of dwellings which house the people—the shack of the South, the adobe hut of California and the South-West, the multiple dwelling with its common stairway and water-closet, the two-family house, one family occupying the ground floor and the other the floor above; the double house, semi-detached, separated by a partition, with separate entrances, but under a common roof—all these being the homes of the poor and working classes.

It seems curious to find the row-upon-row style common in English towns, the dreadful, if necessary, consequence of the industrial revolution a century ago and the jerry-builder's activities, commended by Mr. Veiller, who, in this connection, says: "Then there are what are known as row houses, small houses built in solid rows, extending for a whole block—that is, a property subdivision 200ft. in depth or more, and anywhere from 400ft. to 800ft. in length. This is the prevailing type in England, and has been employed here as the homes of many people for nearly 100 years. This is particularly true of the great city of Philadelphia and of Baltimore and Washington, and other cities in that neighbourhood. Strangely enough, this excellent type of housing accommodation has not spread throughout the country. In the more recently developed section of the country, the detached single-family dwelling, with light and air on four sides, is the prevailing type."

The American people are enjoying unprecedented prosperity—the motor car is no longer regarded as a luxury; but we find that the great mass of the

* No. VIII. appeared February 7th.

people live in a way that is not good for them, though "they may look upon the automobile as much a part of the equipment of their home as they do their bath tub or their water-closet." In 1920 there were twenty million dwellings and twenty-four million families, an average of 1·2 familes to each house. But this statement fails to convey the seriousness of the actual situation, which is aggravated in a centre like New York, where slum life is as much a feature of the common life as it is in London—and with much less excuse. One-third of the population of New York—that is, two millions of people—"live under unsatisfactory conditions, many under distressing conditions, some under disgraceful conditions. For thousands home is a mockery. It consists of two or three small rooms, of which but one is adequately lighted—and often even not that one—and none of which is adequately ventilated; rooms that in the hot summer days and nights become an inferno of torture to little children, the sick and the weak. For the persons living in these houses there is little privacy; there are no reticences; they must share the processes of living with other families; they must use a common water-closet; they must get all the water they use from a common faucet in the public hall; the fire peril menaces them at all times." The foregoing is part of a statement made recently by a Committee on Plan and Survey, appointed by the Mayor of New York.

A quite interesting part of the paper deals with comfort in the home, the "whole trend in America being towards greater ease in living." A study made by the General Federation of Women's Clubs, covering twenty-two cities, each with over 100,000 population, embracing 1,722,570 family groups, aggregating 6,787,737 people, revealed that—

60	per cent.	of homes owned both telephones and motor cars.
79	,,	of houses were lighted by electricity.
74	,,	used gas for cooking.
70	,,	were equipped with electric irons.
60	,,	were supplied with telephones.
61	,,	with automobiles.
59	,,	had gas heaters.
47	,,	vacuum cleaners.
23	,,	power-driven washing machines.

The statistics-loving Americans went further and discovered that in some thirty-seven American communities, selected as typical—

31·8	per cent.	had annual incomes of 2000 dollars or less.
28·8	,,	from 2500 dollars to 3000 dollars.
5·2	,,	,, 3500 ,, 5000 ,,
6·9	,,	,, 5500 ,, 9000 ,,
5·2	,,	more than 9000 dollars.
60	,,	of homes visited kept at least one car.
7	,,	owned several.
26·9	,,	of homes visited were valued at from 4500 dollars to 6000 dollars each.
24·6	,,	from 6500 dollars to 8000 dollars each.
5·2	,,	valued at 20,000 dollars or more.
84·8	,,	of homes visited had bathrooms.
1·7	,,	of homes had electric refrigeration.
89	,,	of families had no regular servants.

The author contrasts Philadelphia with New York, very much to the advantage of the former. In the Quaker city, as in London, the authorities have decided against the skyscraper, against sunless streets, with the people gasping for breath in the summer and frozen to death in the winter. New York is "becoming a sunless city. Few rooms now receive the direct rays of the sun, and many never receive them at any hour of the day or at any season of the year." Thus what London bewails because of Nature's gloom, in New York is man's own creation. As to overcrowding, the author expresses the view that nowhere else in the civilised world can conditions of overcrowding be found similar to those of New York, "or even conditions remotely approaching them."

The spirit of Fascism breathes in the many Italian papers contributed to the Congress—the improvement of the condition of the people is an idea that dominates the Italian official mind.

Drainage and Reclamation in Italy, by Antonio Buongiorno, "Ingegnere Capo del Genio Civile," is one of these. It is highly technical regarding the national laws on the subject; it shows how the South has been neglected in the past, while the North has had the constant attention of Italian States in all ages. The Fascist Government, undoubtedly, has inaugurated a great national work, the meritorious objects of which are made clear by Mr. Buongiorno's paper.

Two papers by Engineer Guido Ucelli, dealing respectively with *Hydraulic Machinery*, *Power Plants* and *The Turbine Industry*, emphasise the fact that in all things appertaining to water the Italian contribution is too distinguished to be overlooked. In both his papers, the author reminds us that the imperishable record begins with Archimedes, 287–212 B.C., while the most illustrious of all Italians, Leonardo da Vinci, 1452–1519, was the first to "conceive new hydraulic motors that have a wonderful analogy with modern constructions, as appears from his 'Atlantic Code.'" A list is given of famous Italians and their contributions to science, reminding us that the contributions to scientific knowledge made in the nineteenth and twentieth centuries are not more marvellous than those made in the Middle Ages, when man was so confined and circumscribed spiritually and mentally.

In the paper on the Italian turbine industry, there is a list of Italian patents and the chief manufacturers, and at the end reference is made to the dredging of Lake Nemi and the uncovering of the old Roman galley 2000 years hidden from sight.

Hydrographic Service in Italy, by Eng. Angelo Rampazzi, of the Ministry of Public Works, is another of the Italian papers marked by perfervid patriotism. Although Padua possesses the longest series of continuous meteorological records, going back without a break for many generations, and hydrometers have been read for many decades it is only within the past twenty years that there has been developed a complete hydrographical service, now a valuable servant of the nation, both in the enterprising North and more neglected South. The long-neglected southern provinces, however, are now receiving all the attention they require. Full details are given of the meteorological and hydrostatic stations, and the very thorough efforts being made to control, exploit and reclaim rivers and marshlands and restore them to agriculture.

Another paper revealing the extraordinary development work going on practically unnoticed in Japan, gradually transforming the lives of the people, is that entitled *Industrial and Domestic Electric Heating in Japan*, by Y. Ishikawa, Chairman of the Electrical Association, Kansai Branch, and managing director of the Kioto Electric Light Company.

Let me repeat, the Japanese from being the most conservative of peoples have, within the space of a generation, undergone a complete change and recovered the qualities we may well suppose they possessed in the Middle Ages, before their country was closed to all foreign intercourse in the sixteenth century as the consequence of alleged political activity of the Jesuit missionaries, who first landed in 1542, and were converting the people by the hundred thousand. With the new liberties gradually acquired during the past fifty years, they have completely thrown off the suspicion with which they were taught to regard everything foreign, and to-day they are ready to consider anything, in all fields. They receive everything on trust, try it, and if it serves their purpose, discard the old without a twinge. Tradition means nothing; old custom a thing to laugh at, but a riot would be caused if they forgot to bow to each other an unending number of times when they meet. The people posted 700 million congratulation postcards at the New Year; thus at least maintaining traditional custom in one particular. But despite these survivals, they appear to be far more go-ahead than the English in the adoption of new things that will expedite work, save costs and labour.

It is only fifteen years ago that the first electrical heater was seen in Japan. Twenty-four electrical cooking stoves of German make were installed in an enterprising native-style restaurant in Osaka; and in the same year, 1915, there was a demonstration in Kioto before princes and nobles assembled in the ancient capital for the enthronement of the late Emperor Taisho. In the largest public hall in the city thirty-six electrical heaters of 150-kW aggregate capacity were installed. Says the author: "This pioneer show, which continued for several days, was received by the public with curiosity and admiration, and although it was a temporary installation, the public gained some knowledge of the adaptability of electric power to room heating."

The increasing prices of old-time fuels, coal, charcoal, and wood, were the chief factors in the rapid development of electric power, and also, of course, in the now universal recognition of the country's enviable configuration for the conversion of water power, which must ultimately prove of the very greatest advantage in lessening the costs of industry.

There was a memorable water power boom in Japan during and immediately after the Great War, followed by the unprecedented slump of 1920, when hundreds of bubble companies did no more than take the money of the shareholders. This retarded the development of many electrical concerns, which were building generating stations, but the utility of electrical power and heat, the efficiency, economy, and cleanliness associated with the new industry, ensured its progress. To-day both power and heat are used in the remotest parts of the empire, for very many purposes, and the author gives an interesting list of the trades that are directly benefited by the new source of heat.

The paper contains some illuminating figures on labour and power costs, which are driving Japan along the road of greatest efficiency, meaning the elimination, as far as possible, of man power and human skill, and the author does not fail to note the inefficiency of local labour compared with that of Japan's chief competitors in the world market. The rise in daily wages in Japan during the past fifteen years, as given in the paper, may be summarised as under:—

	1914.	1929.
Foundry worker	·80	2·70
Blacksmith	·80	2·70
Carpenter	1·5	3·20
Plasterer	·94	3·28
Stonemason	1·25	3·50
Unskilled	·73	2·33

And fuel costs:—

	1914.	1929.
Kerosene, 10 gallons	4·33	6·38
Coal, ton	8·23	23·30
Charcoal, bag	1·30	1·95
Wood, bundle	·13	·31

The latter prices were greatly exceeded during the boom years, 1917–20.

The author, it goes without saying, is an enthusiastic advocate of the new power, which is spreading in the factory and the home, slowly revolutionising the mode of life, and giving rise, incidentally, to new problems, connected with the unemployed.

Literature.

The Reorganisation of Crewe Locomotive Works. London: The *Railway Engineer*. 1929. Price 15s. net.

AMONGST railway locomotive works there are none more famous in the world than those of the old London and North-Western Railway at Crewe. Great men have ruled over them in the past. Trevithick started them in 1843, Ramsbottom followed him in '57, and in 1871 Webb took charge. During his energetic reign many developments took place, and visitors from all over the world came to see a factory which was unique in completeness. But the hand of Time stands still in factories, and every now and then they have, so to speak, to be taken to pieces and reconstructed to meet new conditions and new ideas. That was the fate of Crewe. Reorganisation became necessary after the war, and under Sir Henry Fowler—after the London and North-Western ceased to exist—the renovation was pushed forward energetically and with great skill by Captain Beames. In a paper which he presented to the Institution of Mechanical Engineers in 1928, he described and illustrated many of the more important changes and innovations—particularly the "belt" for repairs—but could not cover the whole ground in the allotted space. That was done in a very complete series of articles in the *Railway Engineer*, which are now re-published in book form. It is claimed, and we believe justly, that this is "undoubtedly the most complete description of the locomotive building and repairing organisation of a British railway that has ever appeared in print." It is copiously illustrated from photographs and plans and contains many copies of the forms used for the route-ing and recording of material, which will interest works managers. With it the reader may profitably study the paper on the repair organisation at Derby which Sir Henry Fowler gave recently to the Institute of Transport. Altogether, a book which railwaymen, be they professional or amateur, will be glad to possess.

BOOKS RECEIVED.

Annales des Travaux Publics de Belgique. Tome XXX. 1929. 6e Fasc. Décembre. Brussels: Goemaere, 21, Rue de la Limite.

An Outline of Metallurgical Practice. By Carle R. Hayward. London: The Library Press, Ltd., 83, Southwark-street, S.E. 1. Price 30s. net.

Clubs, 1930. Edited by E. C. Austen Leigh, M.A. London: Spottiswoode, Ballantyne and Co., Ltd., New Street-square, E.C. 4. Price 7s. 6d. net.

Ingénieurs Civils de France: Mémoire et Compte Rendu des Travaux, Bulletin de Juillet-Août, 1929. Paris: Hotel de la Société, 19, Rue Blanche (9e).

Air Photography. Part II.: Theory and Practice. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 4s. net.

Building Science Abstracts. Vol. II. (New Series), No. 12. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 9d. net.

The Corrosion of Lead in Buildings: Building Research Technical Paper No. 8. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

Transactions of the Institution of Naval Architects. Vol. LXXI. Edited by R. W. Dana, O.B.E., M.A., &c. London: The Institution of Naval Architects, 2, Adam-street, W.C. 2.

Sydney Harbour Trust Commissioners: Twenty-ninth Report, being for the Year ended June 30th, 1929. Sydney, N.S.W.: W. A. Pepperday and Co., Ltd., 757A, George-street. 1929.

The Law Relating to Injuries to Workmen. Fourth edition. By F. G. Neave, LL.D., in collaboration with G. Turner, M.A. London: Effingham Wilson, 16, Copthall-avenue, E.C. 2. Price 6s. net.

The Prevention of Corrosion of Lead in Buildings: Building Research Bulletin No. 6. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 4d. net.

Motor Repair and Overhauling. Part I. Edited by G. T. Clarke, to be published in 24 weekly parts. London: George Newnes, Ltd., 8–11, Southampton-street, W.C. 2. Price 1s. net.

Motor Ships of the World and Motor Shipping Register. Edited by A. C. Hardy, B.Sc., F.R.G.S., &c. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. Price 12s. 6d. net.

Annali dei Lavori Pubblici (Gia Giornale del Genio Civile), Ministero dei Lavori Pubblici, Consiglio Superiore. Fasc. 11. Novembre, 1929. Rome: Provveditorato Generale dello Stato, Libreria. 1929.

Hints for Commercial Visitors to the Argentine Republic By Mr. E. J. Joint, the Acting Commercial Counsellor at H.M. Embassy at Buenos Aires. London: The Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

Introduction to Statistical Mechanics for Students of Physics and Physical Chemistry. By James Rice, M.A. London: Constable and Co., Ltd., 10–12, Orange-street, W.C. 2. Price 18s. net.

Surface Water Supply of Canada: Pacific Drainage—British Columbia and Yukon Territory—for the Climatic Year 1926–27, being Water Resources Paper No. 59, of the Dominion Water Power and Reclamation Service of the Canadian Department of the Interior. Copies can be obtained free of charge on application to the Director of the Dominion Water Power and Reclamation Service, Ottawa, Canada.

Re-boring Machine for Motor Car Cylinders.

IT is a well-known fact that the wear which occurs in the cylinders of motor car engines is not of a uniform character. If the reciprocation of the piston rings up and down against the walls were alone responsible for the wear the bore would remain substantially circular and the wear would be taken up by the expansion of the rings. There are, however, other factors which cause wear to take place unevenly and in a manner which eliminates the possibility of its being taken up by the expansion of the rings. During the compression stroke, for example, the inclination of the connecting-rod results in the piston being thrust against one side of the cylinder with a varying force, and during the combustion stroke the inclination of the connecting-rod in the opposite direction results in the piston being forced against the opposite wall. As a consequence of this action, the general tendency is for the bore to wear oval and tapered. It is also to be noted that as the side thrust on the piston is greater during the combustion stroke than during the compression stroke the oval to which the bore wears will not be concentric with the original circular cross section. It is important to observe, however, that as the piston stroke stops just short of the top end of the cylinder a short portion of the original bore will be left unaffected by the wear.

Another fruitful cause of uneven wear is to be found in bent or twisted connecting-rods. It is stated that 90 per cent. of used motor cars have been found to have one or more of their connecting-rods bent or twisted. This defect results in the top of the piston being forced against one wall and wearing it over the length of the piston travel, while the skirt of the piston is forced against the opposite wall and produces wear also over the length of the piston travel. As the wear on the one wall is not at the same level as the wear on the other, the effect

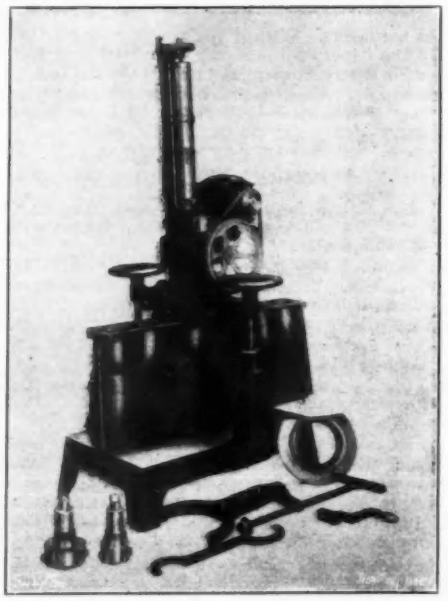


FIG. 1—STORM CYLINDER RE-BORING MACHINE

is that the mean bore of the worn cylinder is not parallel with the original bore.

In general, therefore, the bore of a used motor car engine cylinder is oval, tapered, displaced and inclined. To prevent the loss of power which must ensue and other objectionable results of this wear, it is customary to reform the bore, commonly by grinding—in which case a new over-size piston will be required—or by machining the walls sufficiently to permit a liner possessing the original bore to be inserted. In a block of four or six cylinders, it is desirable that all the reformed bores should be of the same diameter in order that the interchangeability of the pistons may be preserved. It therefore follows that the amount of metal to be removed to restore the bores to a uniform truly circular section with their axes correctly spaced and aligned is determined by the worst worn cylinder.

There are certain processes in use which reform the bore to a truly circular section, but which do so simply by cleaning up the high spots without reference to the alignment and position of the bore as altered by the wear. In the Storm re-boring machine—illustrated in Figs. 1 and 2—provision is made for accurately setting the cutter over the original bore and for guiding it downwards co-axially with the original centre line. The facts depended upon to secure accurate setting and grinding of the cutter are that, as has already been noted, the piston does not wear the extreme top end of the bore, and that originally the bore was at right angles to the machined top face of the cylinder block casting. The machine consists of an inserted tooth cutter at the end of a power-fed boring bar, a base for supporting the cylinder block, and a bracket whereby the boring column and its details can be clamped in position relatively to the bore to be machined. The boring column before it is clamped is free to move on the bracket in any direction. It is adjusted by hand until the cutter is approximately over the mouth of the bore. The cutter teeth—see Fig. 3—have their points bevelled to a cone, and when the cutter is fed down by hand these conical points enter the bore, and as a result the whole boring column is brought bodily into accurate alignment with the bore. The head is then clamped in position, the clamping system operated by the pair of hand wheels seen in Fig. 1 being such as will not, when operated, disturb the position of the cutter relatively to the bore. The clamping action brings the base of the boring column firmly down against the top face of the cylinder block, and as the cutter feed occurs truly at right angles to the plane of the boring column base the bore is re-machined in the original alignment.

The cutter—Fig. 3—carries six blades disposed in radial

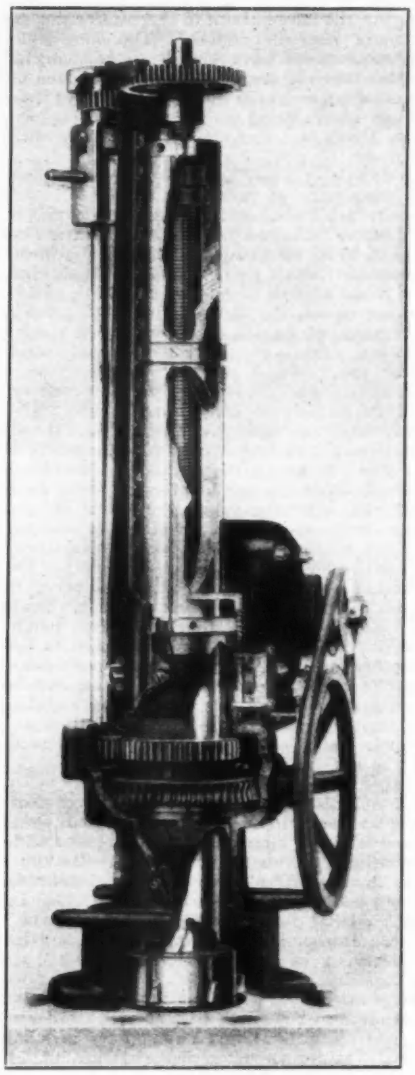


FIG. 2—RE-BORING MACHINE

slots. The inner ends of the blades are bevelled and make contact with a cone at the end of an adjusting screw. If the square end of this adjusting screw is held in a vice, and if the body of the head is turned round, the blades will move outwards. They are in this way

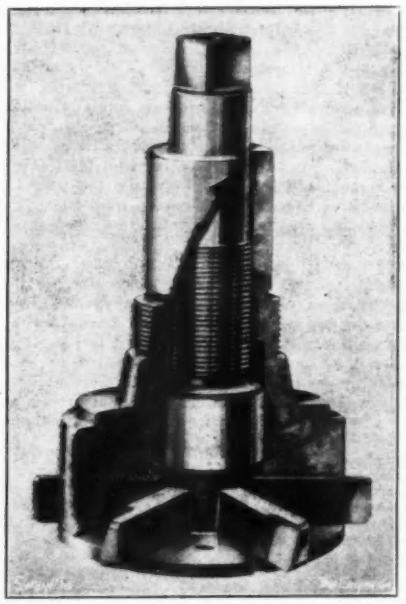


FIG. 3—CUTTER HEAD

set by micrometer to the diameter decided upon for the re-bored cylinder. Once the blades have been set to the required diameter, the cutter can be inserted in the machine. The blades do not require to be locked in position. In fact, no locking gear is provided.

The machine is driven by a ½ horse-power motor mounted on the side of the column. It, as shown in Fig. 2, drives the cutter boring bar through a belt and worm and worm wheel. The boring bar consists of a hollow sleeve engaging with the worm wheel through a key and axial spline. The downward feed of the boring bar is applied by an internal square-threaded screw driven by a spur wheel and pinion at the lower end of an external feed shaft and by change feed gearing at the upper end. The boring bar is guided by two adjustable tapered bearings, one

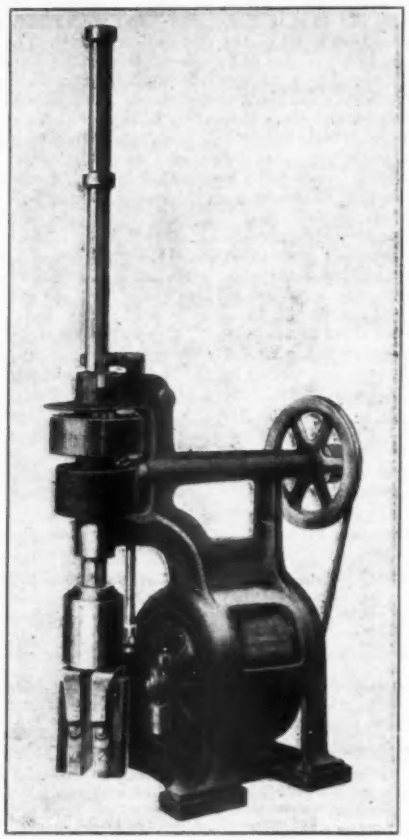


FIG. 4—HONING MACHINE

above and one below the worm wheel drive. An adjustable collar can be moved up or down on the boring bar, and is set against a scale representing the depth of the cylinder to be machined. When the bore has been completely traversed the collar makes contact with a switch arm and shuts off the motor. A crank handle applied to the upper end of the feed screw enables the boring bar to be raised quickly by hand out of the cylinder at the end of

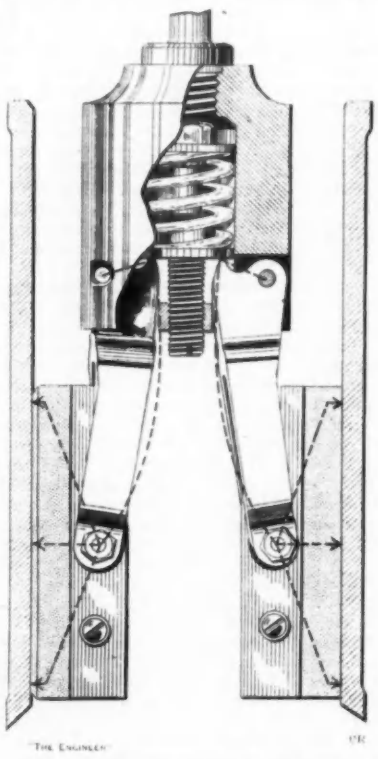


FIG. 5—HONING HEAD IN CYLINDER

the cut, or the cutter to be inserted into the mouth of the bore at the beginning of the operation for centralising purposes. The cutter body is screwed into the nose of the boring bar and is accurately positioned on a conical seat.

The average cut taken by the machine is about 25-thousandths of an inch, but the machine is capable of taking a cut up to $^{9}/_{32}$in., equivalent to an increase in the

diameter of the bore of $^{3}/_{16}$in. In a demonstration recently carried out in our presence, the machine was set to take a cut of 35-thousandths of an inch on a cylinder 8¾in. long. The time occupied for the complete machining of the bore was about 20 min. As shown in Fig. 1, the cylinder block casting before machining is begun is dismantled from the car, and it will be noted that the studs have to be withdrawn before the machine can be applied to the cylinder casting. It is also possible to employ the machine on the cylinder block without removing it from the car. For this method of working the table and the bracket are not used. Instead, the boring bar column, centralised in the manner previously described, is bolted by the rowlock-shaped dog, seen in the foreground of Fig. 1, directly to the top face of the cylinder block.

For most purposes the surface left on the bore after the cutter has done its work on it is sufficiently smooth to permit the cylinder to be put into re-use without further preparation. If a gun-barrel finish is required, the automatic honing machine illustrated in Fig. 4 is employed after the machining has been completed. This machine is a simple electrically driven appliance, which is set up on the top face of the cylinder block without clamps, its own weight being sufficient to maintain it in position. The carborundum hones centralise themselves automatically in the machined bore. The arrangement of the hones is illustrated in Fig. 5. A central master spring transmits an equal pressure to the mid point of each hone, thereby causing the hones to press with equal force against the walls of the bore. In general, the hones, lubricated either with water or paraffin oil, are passed up, down and up the bore, the amount of metal removed being about half-a-thousandth of an inch. The hones can be adjusted to deal with all diameters from 2⅛in. to 8in.

These machines are made by the Storm Manufacturing Company, of Minneapolis, for which the Clark Automotive Equipment Company, 11¼, Great Dover-street, London, S.E. 1, is the British agent.

Canadian Engineering News.

(From our own Correspondent.)

Big River Diversion Scheme.

ONE of the most ambitious river diversion projects ever undertaken in Canada is being pushed forward by the British Columbia Electric Company at Ruskin, B.C., where the torrential Stave River is being turned aside from its course and run into a new channel and harnessed. This difficult undertaking is attracting universal attention. Upon its success depends a number of other canyon diversion tasks where extensive power plants are planned in the gorges of the mountain streams for hydro-electric purposes. This project is the third successive stage of hydro-electric development which the British Columbia Electric Company has undertaken on the waters of Stave Lake and Stave River. It is by far the most difficult of the three, and it will be most remarkable in many respects; for, in addition to the obvious engineering and hydraulic problems that will have to be overcome, the Ruskin plant will be noteworthy because it will utilise, for the third time, water that has twice previously been used for the generation of electrical energy. There are two similar projects under consideration in the State of Washington, and several in the interior of British Columbia. If the methods used for diversion and control which are being applied at Ruskin are successful, it is expected that work will be immediately started on the other undertakings.

Distribution Transformers.

The Canadian Engineering Standards Association has published the second edition of its standards for single-phase distribution transformers. The first edition was published in 1920, and the revision now published is the result of the experience which has since been gained in the practical use of the document. The capacity limit of distribution transformers has been increased from 100 kVA to 200 kVA, for large distributing systems now find it advisable to use many transformers in capacities larger than 100 kVA. The former rated voltages of 2200 and 4400 have been changed to 2300 and 4600 with corresponding alterations in tap voltages. A few additions have been made to the list of rated capacities, and all of these changes have been made with the view of adapting the specifications more closely to actual conditions and the requirements of the users.

Increase in Refining and Smelting.

A striking feature of the Federal Government report on the Canadian nickel-copper industry and its progress during 1928 is the increase in the amount of refining carried on in the Dominion. Though the amount of matte from the smelters containing nickel, copper and precious metals exported for further treatment increased from 33,541 tons in 1927 to 39,310 tons in 1928, the more significant increase was in the amount of matte shipped to Canadian refineries, which increased from 39,942 tons in 1927 to 66,463 tons in 1928. The total estimated value of the output in matte exported and refinery products produced in 1928 was 32,494,359 dollars, against 21,594,078 dollars in the previous year. Mining, smelting and refining of nickel-copper ores of the Sudbury district in Ontario showed a great improvement over 1927. More ore was treated by the smelters, and, as a consequence, more matte was produced and a larger output of refinery products was obtained than ever before.

To Enlarge Nickel Plant.

Plans are at present under consideration for the addition of equipment sufficient to double the capacity of the International Nickel Company's new concentrator at Sudbury, Ontario. Originally, the concentrator was planned with a capacity of 4000 tons, but recent metallurgical experiments and developments have made it advisable to increase that capacity to 8000 tons a day. This plan will necessitate little change in the construction of buildings housing the plant, the addition of more units to the present equipment being all that is necessary to produce the larger output. Included in the proposed plan for the enlarged concentrator is a process for floating off a large portion of the copper, a method which will permit of the direct production of a quantity of blister copper, thus obviating the necessity of smelting. The nature of the company's Frood ores, which carry an exceptionally high percentage of copper on the lower levels, with little change in the percentage of nickel secured on the upper levels, allows for that treatment, the cost of which is materially below those involved in the production and refining nickel-copper matte. The nickel-copper concentrates which will contain the biggest percentage of previous metal content of the ore will be treated in the new smelter, which will have a capacity of 6000 tons a day. As the ratio of Frood ore to concentrates produced is about eight to one, the new plan will produce 1000 tons of concentrates for treatment in the smelter instead of 500 tons as originally planned.

Noranda Attains Objective.

Completion of the Noranda Mines' big expansion programme in North-Western Quebec, involving an expenditure of some 10,000,000 dollars, was reached at the end of November, when twin smelter units were placed in operation on the basis of 2000 tons of ore per day. Nos. 3 and 4 shafts were also worked simultaneously and the big smelter settled down to what henceforth will be its daily schedule. The entire mechanical equipment is reported to be working to complete satisfaction. Noranda's rise has been rapid. Six years ago it was a raw prospect in the wilderness, 50 miles from the nearest railway. The first 500-ton smelter was brought into production in December, 1927, and the second unit a year later. The production of blister copper in 1928 was 33,307,937 lb. A 500-ton concentrator was placed in operation in October, 1929, and the capacity since then has been increased to 1000 tons.

To Utilise Smelter Fumes.

Work has begun on the new plant of Canadian Industries, Ltd., at Copper Cliff, Ontario, where the company is establishing an important industry to utilise smelter gases from the International Nickel Company's nickel-copper industry. The initial plant and equipment, which will involve an expenditure of 1,500,000 dollars, is for the production of sulphuric acid and nitre cake. The bulk of the sulphuric acid at first produced will be used to treat sodium sulphate shipped from Saskatchewan in order to produce the nitrate cake for which Canadian Industries, Ltd., is under contract to supply the International Nickel Company. It is hoped that from time to time, as new chemical developments based on smelter fumes prove commercially feasible, plant extensions will be made, and the company is engaged at the present time in active research work along those lines.

Plans to Increase Zinc Output.

Steps are now being taken materially to increase the production of zinc in Canada. At least ten zinc producers, in the making, are being developed in the Dominion at the present time. These ten companies promise to contribute some 390,000,000 lb. of zinc to the country's output. The Consolidated Mining and Smelting Company has just been completing a 50 per cent. increase in the capacity of its zinc mill, and in view of the fact that production of zinc last year by this company was 163,000,000 lb., an additional production of 82,000,000 lb. annually appears in prospect. That would bring the total increase within the next few years to approximately 470,000,000 lb.

May Use Coal to Smelt Ore.

Commercial utilisation of Canada's low-grade iron ore and coal, whereby the Dominion may attain independence for her steel industry, is predicted with the practical application of a new reduction process now receiving the Government's support. Announcement was made recently on behalf of the Playfair-Ross interests that rights to the Musso semi-direct steel process have been acquired and that arrangements have been completed with the Federal Department of Mines to permit the erection of a pilot plant at the National Research Laboratories, Ottawa, for the purpose of demonstrating the process. Officers of the Department of Mines will collaborate with the inventor, Alfred Musso, and his representatives in the demonstrations. It is claimed for this process that profitable commercial use of low-grade ores and coals, of which the Dominion has an abundant supply, may now be found. The steel industry in Canada is said to be practically dependent on the supply of coal and ore from the United States at the present time, 70 per cent. of requirements being imported. The new process was introduced to Canada by Norman A. MacLeod, a British subject, through whom the Playfair-Ross interests have acquired the option rights for Canada and the rest of the world, exclusive of the United States and Italy. The rights for the two latter countries remain in the hands of the inventor and his associates.

Electrification of Rail Mill.

Electrification of the tables in the rail mill at the Sydney plant of the Dominion Iron and Steel Corporation is being carried out. Some time ago a portion of the power used in the rail mill was changed over to electricity, but heretofore the pressure for the large tables on which the steel rails are rolled has been supplied by hydraulic power. Under the new arrangement it is stated that tables can be operated more efficiently and economically.

Use for Natural Gas.

Another big steel plant has gone into operation in Western Canada. It is the new plant of the Manitoba Rolling Mills Company, at Calgary, Alberta. Steel is being poured from the 25-ton open-hearth furnace at the rate of 70 tons of ingots daily. The plant has been completed at a cost of 600,000 dollars and occupies 18 acres of land. An interesting feature of the new industry is the use of natural gas as the heating element, thus providing an outlet for some of the enormous supplies of gas available from the Turner Valley oilfield. It is stated that the consumption of natural gas will be approximately 1,500,000 cubic feet per day.

132,000-volt Line in West.

As a consequence of an agreement entered into recently by the Calgary Power Company to supply the city of Edmonton with hydro-electric energy from the company's power developments on the Bow River, the province of Alberta will have the highest voltage electrical transmission line in Western Canada, and at present exceeded by only two other lines in the whole of Canada. The Edmonton contract will involve construction of a 132,000-volt line. At present this voltage is exceeded only on the Shawinigan Water and Power Company's line between the Saguenay River and the city of Quebec —165,000 volts—and the new line of the Ontario Hydro-electric Power Commission, supplying Toronto from the Gatineau River in the province of Quebec—220,000 volts. Sub-station equipment will be installed during the winter months. It is expected the line will be completed and in operation early this year.

Plant to Distil Coal.

British capitalists are reported to be interested in plans for the construction of a plant in the Prince Rupert district of British Columbia for the treatment of coal by the Bussey coal distillation process. Part of the plan of this enterprise calls for the building of a railway from a point near Telkwa to Vanarsdol, on the Canadian National line, and south from that point to the head of the Kitimat Arm, to ensure cheap distribution. It will mean a railway 148 miles long and costing in the neighbourhood of 15,000,000 dollars. The application for a charter for the railway will be renewed at the next session of the Provincial Legislature. Pending completion of the elaborate detail work connected with the proposed establishment of a reduction plant, it is the intention to proceed at once with development of the local market for fuel.

Turbine Blade Corrosion.

THE following notes concerning the corrosion of the blading of a steam turbine concern one example cited in an article in *Vulcan*, the journal of the Vulcan Boiler and General Insurance Company, Ltd.

An impulse turbine, having seven stages, was used for driving a generator through double helical gearing, with an extension shaft arranged to drive a mill, the speed of the rotor being 5600 revolutions per minute and that of the rope pulley 428.

This turbine had been at work for about three years when a definite loss of efficiency was noticed. On examination it was observed that the first three rows of blading were very badly corroded; in fact, in some parts very little of the original metal remained.

The fourth stage blading was severely corroded on the inlet edges and slightly corroded on the discharge edges. The cast iron diaphragms showed clearly the progressive nature of the corrosion, it being noted that the first stage was so badly affected that in some places there was no trace of the original nozzle, and it was quite easy to pick out the sequence of the diaphragms by observing the extent of the corrosion, which was progressively less towards the low-pressure end of the turbine.

Considerable pitting was also observed on the rotor wheels, particularly at their hubs and nearer the circumference of the wheels, at the radius where the section was increased to take the blading. This pitting may have been due to a slight leakage of steam past the stop valve at some time whilst the turbine was shut down, the drops of water arising from condensation on the wheels having, no doubt, collected at the places where the deepest pitting was found.

The second stage nozzle blades were corroded at the discharge edges of many blades. In the case of the third stage, the inlet edges were slightly corroded and the discharge edges severely so; indeed, they were actually punctured in places. The inlet and discharge edges in the fourth stage were also corroded in many places.

When the turbine was constructed, the first six rows of blading were made of 3 per cent. nickel steel and the last row of stainless steel. These latter were found to be in satisfactory condition and, in fact, the low-pressure end of the turbine from the fifth stage of blading did not appear to have been effected by corrosive action.

On reviewing this case, it appears strange that after 18 months' work the blading was reported to be in good condition, and then after a further 18 months its condition was as described. The only conclusion that could be arrived at was that some foreign matter had been carried over with the steam from the boiler, although there was very little to which exception could be taken, judging from a chemical analysis of the entering feed water and samples from the boiler itself.

It should, however, be borne in mind that these water tests only represented the conditions prevailing at the particular time when the samples were taken, and gave no idea of the intermittent working conditions that may have prevailed.

In view of the state of the turbine after the first 18 months' work, it is permissible to assume that the corrosive action had been intermittent. Another point to note in connection with this case is that the water in the well underneath the cooling tower would, no doubt, be in an aerated condition and, consequently, it would have a high oxygen content, and if some of the feed water for the boilers had been drawn from this source it would, no doubt, tend to facilitate corrosion. It may be mentioned that when this turbine was re-bladed, stainless steel was used for the replacements.

A WIRELESS station for meteorological purposes has been erected in Franz Josef Land by the Soviet Government.

General Operation Experiences with the First "Wood" Steam Generator.*

By E. WATSON SMYTH, of Manchester.

(*Concluded from page* 170.)

PARTICULARS OF PERFORMANCE AND OBSERVATIONS OVER TEN MONTHS' DAILY OPERATION DURING 1928.

UPON the completion of this very thorough overhaul the plant was again ready for service early in 1928. The alterations to the position of the pulverised fuel plant delayed progress somewhat, and it was not until March 15th, 1928, that the unit was again under steam, but it has since operated regularly on the works load. The average number of operating hours per week is 135.

The results of the modifications soon became apparent, and the generator was found capable of dealing quite easily with the widely varying load, changing rapidly from 30,000 lb. per hour to peaks of 90,000 lb. per hour without difficulty. A typical steam flow chart has been reproduced in Fig. 17 in order to illustrate the severe operating conditions which the generator is meeting satisfactorily. It will be observed that the load conditions vary so rapidly that the chart is a thick painted section covering the loads indicated many times per hour.

Feed Water Control.—In connection with the varying load it may be mentioned that the control of the feed water occasioned some difficulty which necessitated hand manipulation of the feed water check valves by a permanent operator while the plant was running. Ultimately a special design of feed water control was made which proved successful, and there has since been no necessity for providing labour for hand control.

Staff.—The staff now required for the daily operation of this unit consists of one operator assisted by a fan and pump attendant for each shift of eight hours, who efficiently controls all operating conditions including the soot blowing whenever necessary.

General Observations.—It was found that the equipment of the combustion chamber with soot blowers effected a considerable improvement in the plant operation. When used for a period of two minutes at intervals of about six hours the chamber was kept quite free from slag or ash accumulation. At the end of a full week's operation an internal examination of the chamber was carried out, and the wall tubes were found to be in perfect condition without any sign of deposit on the external surfaces of the tubes.

The final temperature of the steam had been reduced and now remained fairly constant at 650 deg. Fah. Thus the modifications made to the superheater heating surface appeared to have completely remedied the previous difficulties experienced with this section of the plant. The reduction in the heating surface of the economiser had eliminated all signs of steaming at low loads. The heat transfer at high loads also proved satisfactory, the inlet temperature of the feed water being 90 deg. to 100 deg. Fah., and the outlet temperature 300 deg. to 350 deg. Fah. on the normal works load. The de-aerator functioned well, and after many months of service there has been no further serious corrosion apparent in the economiser tubes.

Feed Water.—All the feed water used in the generator from its inception has been town water taken direct from the mains of the Manchester Corporation. No condensing water is available, so that the percentage of make-up feed water is 100. No boiler compounds have been used at any period, and the results appear to have justified the view that compounds are unnecessary. A typical analysis carried out by the West Ham Testing Laboratory is as follows :—

	Grains per gallon.
Silica	0·12
Ferric oxide	0·05
Calcium carbonate	0·72
Magnesium sulphate	0·06
Sodium sulphate	0·21
Undetermined	0·66
Total solids	1·82
Permanent hardness (Wanklyn's soap test)	1·7 deg.

It is customary to "blow down" the boiler once every twelve hours. A typical analysis of the "blow-down" water is given below :—

	Grains per gallon.
Silica	0·27
Ferric oxide	0·09
Calcium hydrate	0·74
Calcium carbonate	1·17
Calcium sulphate	23·92
Magnesium sulphate	0·20
Sodium sulphate	1·71
Sodium chloride	3·78
Undetermined	0·15
Total solids	32·03
Permanent hardness (Wanklyn's soap test)	20·1 deg.

Further Failures.—Following a period of six months' constant steaming a fin tube in the back wall—No. 9 taking the first left-hand tube facing the generator as No. 1—showed signs of blistering about 18in. below the top back drum. This tube was replaced during a week-end, together with two further tubes which revealed signs of similar trouble on examination. The blistered portions of the tubes were submitted to a very critical examination by the research department of the works in the light of two possible causes of the defects, namely : (1) that at high loads the back wall tubes were not getting sufficient water or were suffering from stagnant circulation ; and (2) that creep strains may have been set up in the steel of which the tubes were made.

The first explanation, however, seemed unlikely, since in that case a defect of this nature would not suddenly show itself after the plant had been operating so regularly for upwards of six months. Microphotographs showed no indications of intercrystalline brittleness in the tubes, and it appeared that the points of concentration of stress were probably promoted by slight irregularities in the tubes and not by corrosion centres. The blistered tubes were found to have a layer of scale less than $\frac{1}{16}$ in. thick in places, and a sample of the scale submitted for analysis contained 3·88 per cent. of silica, 4·32 per cent. of ferric oxide, 5·24 per cent. of alumina, 86·56 per cent. of calcium sulphate, and a trace of magnesium chloride. In view of the large percentage of calcium sulphate—plaster of Paris—the cause of the trouble was obvious. It was decided that all the tubes in the generator should be cleaned immediately, and that the removal of scale should be carried out at regular intervals. Since then no further difficulties have been experienced.

Conclusions.—The principle of the radiant heat boiler is

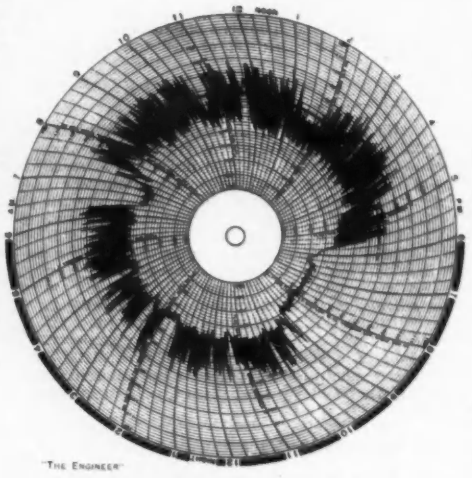


FIG. 17—TYPICAL STEAM FLOW CHART

now accepted by combustion engineers. The design of boilers will no doubt be modified to some extent, but the general principle of surrounding the combustion chamber by water walls, established by the experiments recorded in this paper, will be the chief factor governing future design.

Finally a tribute should be paid to the designer of this boiler, who has worked so untiringly to achieve the degree of success it has attained.

APPENDIX I.

PRINCIPAL DIMENSIONS.

	June, 1926.	December, 1926.
Areas of heating surfaces, sq. ft.—		
Tubes in walls and roof	791·7	791·7
Fins on wall tubes	311·3	311·3
Drums and headers	94·7	94·7
Tubes in water screen	596·7	596·7
Gills on water-screen tubes	1,216·0	—
Superheater	3,470·0	1,489·0
Economiser	—	2,297·0
Air heater	21,760·0	21,760·0
Total water, steam and air heating surface	28,240·0	27,340·0
Total water heating surface, sq. ft.	3,010	4,091
Volume of furnace above water screen, cu. ft.	2,653	2,653
Space between water screen tubes, cu. ft.	244	254
Volume of ash chamber, cu. ft.	1,778	1,450

APPENDIX II.

RESULTS OF TESTS SUPERVISED BY MR. KREISINGER.

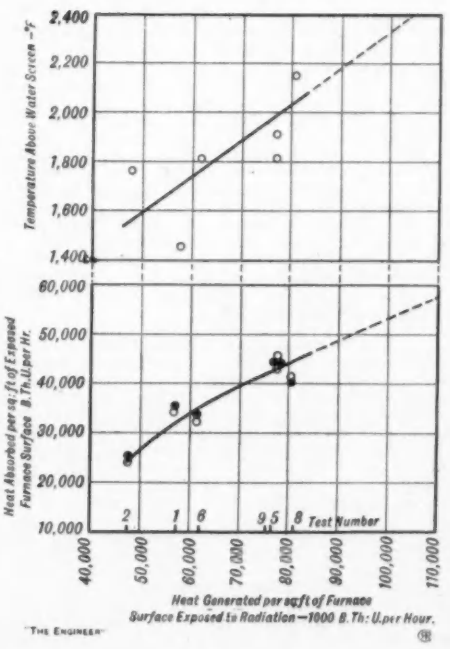
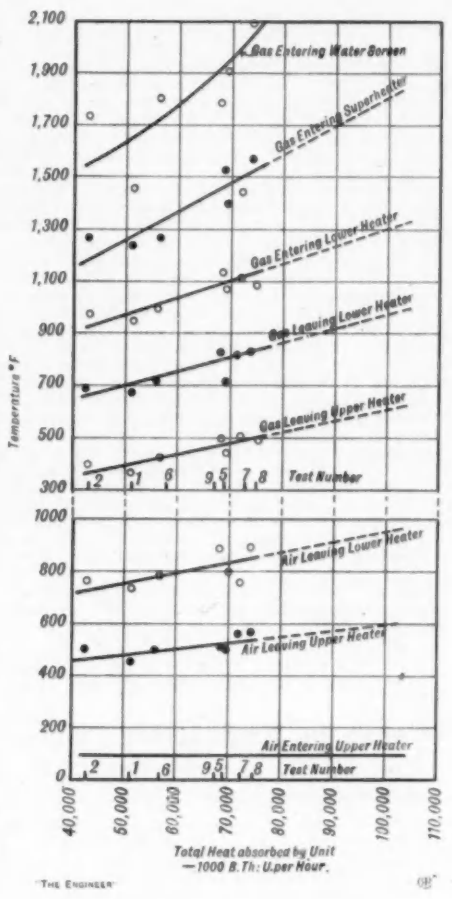

Temperature Above Water Screen—°F.
Heat Absorbed per sq. ft. of Exposed Furnace Surface B.Th.U. per Hr.
Test Number
Heat Generated per sq. ft. of Furnace Surface Exposed to Radiation—1000 B.Th.U. per Hour.
THE ENGINEER

FIG. 18



FIGS. 19 AND 20

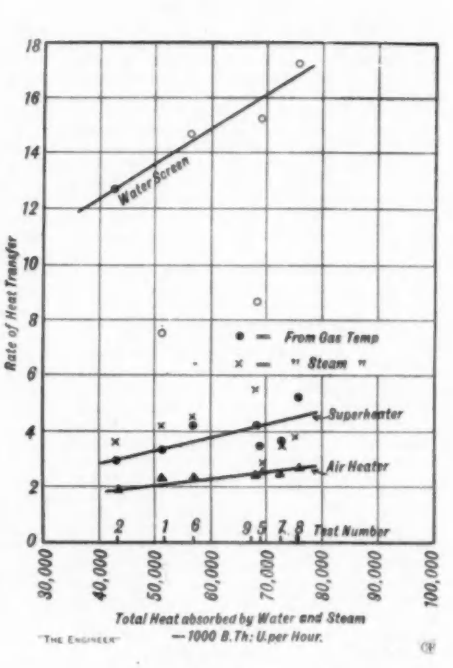


FIG. 21

The rates of heat transfer plotted in Fig. 21 were computed as follows :—

Rate of heat transfer in water screen

$$= \frac{W \times s \times t'}{\left(\frac{t_1+t_2}{2} - t_3\right) \times a_1}$$

where W is the weight of products of combustion, s is their specific heat, t' is the temperature drop of the gases through the water screen, t_1 and t_2 are the temperatures of the gas entering and leaving the water screen respectively, t_3 is the temperature of the steam, and a_1 is the heating surface of the water screen. The heating surface was assumed to be 608·5 square feet, that is, only the surface of the tubes was considered as heating surface ; the heating surface of the gills was disregarded. In computing the heat absorbed by the screen the cooling of the ash passing through the screen was not taken into account ; it would change the results by less than 1 per cent.

The rate of heat transfer in the superheater was computed in two ways : one with the heat as obtained from the temperature drop of the products of combustion passing through the superheater, and the other from the temperature rise of the steam, assuming that steam entered the superheater 100 per cent. dry.

* The Institution of Mechanical Engineers, January 24th.

Rate of heat transfer in superheater

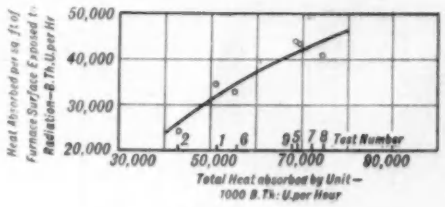
$$\frac{h_1}{a_2\left(\frac{t_3+t_4}{2}-\frac{t_5+t_6}{2}\right)}$$

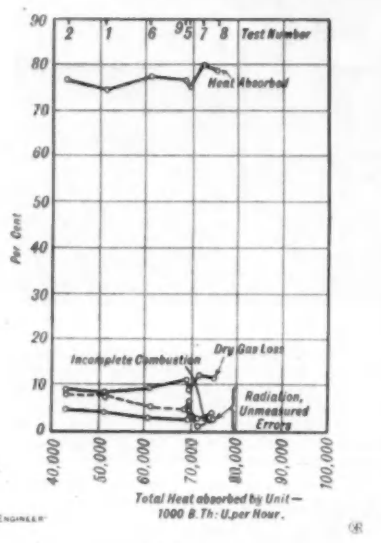
where h_1 is the heat absorbed by the superheater per hour, t_3 and t_4 are the temperatures of the gases entering and leaving the superheater respectively, t_5 and t_6 are the temperatures of the superheated and saturated steam respectively, and a_2 is the heating surface of the superheater. The weight of gases passing through the superheater was assumed to be the mean between the weight of gases leaving the water screen and the gases leaving the air heater.

Rate of heat transfer in air heater

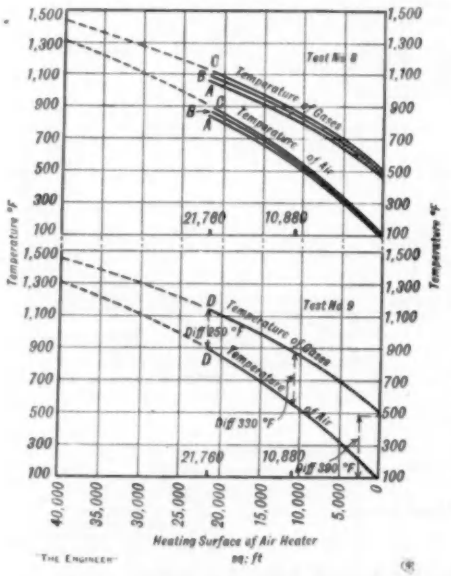
$$\frac{h_2}{a_2\left(\frac{t_7+t_8}{2}-\frac{t_9+t_{10}}{2}\right)}$$

where h_2 is the heat absorbed by the air heater, t_7 and t_8 are the temperatures of the gases entering and leaving the air heater respectively, t_9 and t_{10} are the temperatures of the air entering and leaving the heater respectively, and a_2 is the heating surface of the air heater. In the computation of the heat absorbed by the air heater it was assumed that there was no leakage into the air heater, and that the weight of gases entering the air heater was equal to the weight leaving it.





FIGS. 22 AND 23



FIGS. 24 AND 25—TEST NOS. 8 AND 9

Temperature Drop of Gases and Temperature Rise of Air Through Air Heaters.

A.—Period 10.30 a.m. to 2 p.m. CO_2, 16 per cent.; evaporation, 76,000 lb. per hour act.

B.—Period 3.30 p.m. to 5.30 p.m. CO_2, 14·5 per cent.; evaporation, 62,500 lb. per hour act.

C.—Period 6 p.m. to 7.30 p.m. CO_2, 15·5 per cent.; evaporation, 64,000 lb. per hour act.

D.—Period 2.35 a.m. to 5 a.m. CO_2, 16 per cent.; evaporation, 57,000 lb. per hour act.

APPENDIX III.

Throttling Calorimeter Observations, &c., during Priming Tests, July 16th, 1926.

Time.	Pressure of saturated steam, lb. per sq. in. abs.	Throttling calorimeter. Left-hand. Temperature, t_2, ° F.	Left-hand. Dryness fraction.	Right-hand. Temperature, t_2, ° F.	Right-hand. Dryness fraction.	Temperature of superheated steam, deg. Fah. L.H.	R.H.	Mean dryness fraction.	Feed water temperature, ° F.	Feed water temperature, hotwell, ° F.
10.45	317	310	0·994	317	0·999	718	695	0·9965	65	280
11.00	323	316	0·999	314	0·997	728	695	0·998	65	260
11.15	356	314	0·998	310	0·996	760	730	0·997	65	240
11.30	347	309	0·994	316	0·998	746	717	0·996	65	240
11.45	355	310	0·996	301	0·991	—	—	0·9935	—	—
12.00	340	314	0·997	306	0·993	770	735	0·995	67	240
12.15	399	315	0·999	305	0·993	774	738	0·996	67	240
12.30	335	312	0·996	307	0·994	778	743	0·995	—	—
12.45	362	316	0·999	312	0·996	788	750	0·9975	66	235
1.00	329	316	0·999	312	0·996	790	750	0·9975	66	220
1.15	333	308	0·994	315	0·997	794	758	0·9955	66	230
1.30	355	315	0·999	311	0·997	812	772	0·998	66	230
1.45	345	314	0·998	306	0·993	826	784	0·9955	66	235
2.00	360	315	0·997	311	0·994	812	769	0·9955	65	215
2.15	340	312	0·996	309	0·994	808	764	0·995	65	210
2.30	370	314	0·998	314	0·998	820	774	0·998	—	—

approx.

Dryness fraction calculated from formula $x=(1050+0·48\ t_2-h_1)/L_1$, where x = dryness fraction, t_2 = temperature of steam after expansion in calorimeter, h_1 = sensible heat, and L_1 = latent heat of saturated steam at the pressure before expansion.

APPENDIX IV.

Tests Conducted during 1927.

1. Test number	1	2	3	4	5
2. Date of test, March, 1927	21	22	23	24	25
3. Duration, hours	20·5	24·0	11·6	33·8	24·6
4. Number of burners used	4	8	8	8	8
Temperatures, deg. Fah.					
5. Water to economiser	52	49	47	48	47
6. Water from economiser	252	266	312	284	318
7. Saturated steam	376	394	405	399	393
8. Superheated steam	667	712	748	720	743
9. Steam at calorimeter	289	281	245	276	261
10. Air to upper heater	84	83	89	84	84
11. Air to lower heater	260	305	380	310	355
12. Air from lower heater	433	515	608	520	590
13. Air to feeder	450	535	630	540	605
14. Air and coal at burners	220	240	275	242	250
15. Pulverised coal to bin	90	96	102	100	98
16. Gas leaving upper heater	255	310	350	290	335
17. Gas leaving lower heater	380	450	560	445	520
18. Gas leaving economiser	520	622	758	583	87
19. Gas leaving superheater	900	1,110	1,345	1,132	1,280
20. Gas leaving water screen	—	1,355	1,695	1,503	1,600
21. Gas entering water screen	—	1,860	2,070	1,965	2,084
Pressures.					
22. Steam leaving superheater, lb. per sq. in. abs.	181	220	243	235	216
23. Steam in boiler, lb. per sq. in. abs.	187	230	262	244	228
24. Air entering upper heater, inches of water	0	0	0	0	0
25. Air leaving upper heater, inches of water	−1·7	−1·9	−1·2	−1·5	−1·2
26. Air entering lower heater, inches of water	0·6	0·6	1·9	0·6	0·8
27. Air leaving lower heater, inches of water	0·3	0·2	1·1	0·13	0·15
28. Air to feeder, inches of water	11·0	10·0	10·2	10·0	10·0
29. Air at venturi throat, inches of water	3·8	3·5	3·6	3·5	3·5
30. Air from feeder, inches of water	6·5	6·0	6·0	6·0	6·0
31. Air at burners, inches of water	0	−0·3	−0·6	−0·4	−0·4
32. Gas at top of furnace, inches of water	−0·12	−0·07	−0·13	−0·06	−0·04
33. Gas above water screen, inches of water	−0·30	−0·25	−0·28	−0·23	−0·24
34. Gas below water screen, inches of water	−0·34	−0·35	−0·5	−0·33	−0·37
35. Gas leaving superheater, inches of water	−0·43	−0·41	−0·6	−0·43	−0·49
36. Gas leaving economiser, inches of water	−0·62	−0·7	−1·2	−0·65	−0·74
37. Gas leaving lower heater, inches of water	−0·84	−1·14	−2·2	−1·09	−1·34
38. Gas leaving upper heater, inches of water	−1·00	−1·34	−2·80	−1·25	−1·61
39. Opening of curtains on heater inlets, inches	1·5	2·0	Wide	2·0	2·0
Gas Analysis.					
40. CO_2 at outlet of upper heater, per cent.	12·0	14·2	13·6	14·1	14·3
41. CO_2 leaving economiser, per cent.	13·1	16·0	15·5	15·3	15·9
42. CO leaving economiser, per cent.	0	0	0	0	0
43. O_2 leaving economiser, per cent.	6·2	3·1	3·7	3·9	3·2
Water.					
44. Total fed to boiler, lb.	597,308	964,551	614,993	1,300,410	1,009,052
45. Average evaporated per hour, lb.	29,137	40,190	53,017	38,473	41,918
46. Evaporated per pound of coal milled, lb.	7·0172	7·1767	6·8637	7·2567	7·0386
47. Heat absorbed by economiser per pound, B.Th.U.	209	217	265	236	271
48. Heat absorbed by boiler per pound, B.Th.U.	1,138·5	1,145·6	1,117·4	1,131·0	1,109·9
49. Heat absorbed by economiser per pound coal milled, B.Th.U.	1,403·4	1,557·3	1,818·9	1,712·6	1,997·5
50. Heat absorbed by boiler per pound coal milled, B.Th.U.	7,989·1	8,221·6	7,669·5	8,207·3	7,812·1
51. Heat absorbed by economiser and boiler per pound coal milled, B.Th.U.	9,392·5	9,778·9	9,488·4	9,919·9	9,719·6
Coal.					
52. Total weight to mill, lb.	85,120	134,400	89,600	179,200	143,360
53. Weight per hour to mill, lb.	4,152	5,600	7,724	5,302	5,827
54. Moisture in coal to mill, per cent.	13·41	12·14	14·19	12·52	13·86
55. Moisture in pulverised coal, per cent.	13·08	10·91	12·80	11·91	12·34
56. Ash in pulverised coal, per cent.	5·26	5·26	5·94	5·69	5·42
57. Volatile matter in pulverised coal, per cent.	34·86	34·03	34·77	33·22	33·67
58. Fixed carbon in pulverised coal, per cent.	46·80	49·80	46·49	49·18	48·57
59. Heating value in pulverised coal, B.Th.U.	11,790	12,125	11,645	11,880	11,815
60. Hydrogen in pulverised coal, per cent.	—	—	—	—	5·32
61. Carbon in pulverised coal, per cent.	—	—	—	—	75·25
62. Nitrogen in pulverised coal, per cent.	—	Composite sample	—	—	1·43
63. Oxygen in pulverised coal, per cent.	—	1·5	—	—	10·55
64. Sulphur in pulverised coal, per cent.	—	—	—	—	1·17
65. Ash in pulverised coal, per cent.	—	—	—	—	6·28
Ash from Settling Chamber.					
66. Moisture, per cent.	—	—	—	—	0·64
67. Ash, per cent.	—	—	—	—	83·26
68. Volatile matter, per cent.	—	Composite sample	—	—	5·29
69. Fixed carbon, per cent.	—	1·5	—	—	10·96
70. Heating value, B.Th.U.	—	—	—	—	2,330
71. Fusing temperature of ash, deg. Fah.	—	—	—	—	2,282

Electrical Meters.

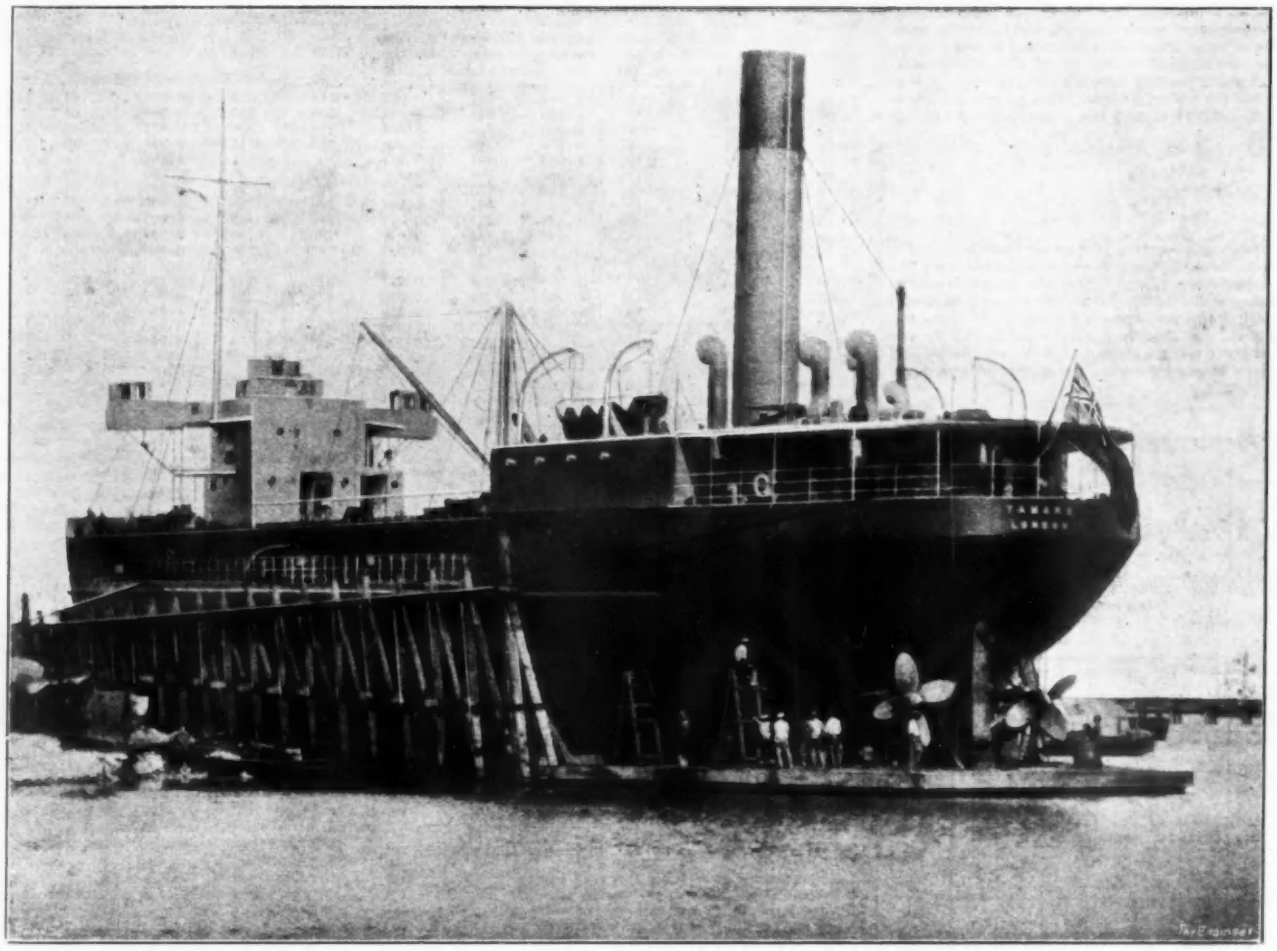
	Amps.
Mill	90
Exhauster	70
Induced draught fan	105
Forced draught fan	150
Primary air fan	85
Coal feeder	2

Power Consumption.

	kW-hours per ton.	kW-hours per ton.
Mill	17·12	
Exhauster	12·615	
Total for mill circuit		29·735
Induced draught fan	7·58	
Forced draught fan	10·838	
Primary air fan	6·14	
Coal feeder	1·445	
Total for boiler circuit		26·003
Total pulverising and burning		55·738

SLIPWAY AT ARUBA, DUTCH WEST INDIES

THE CRANDALL ENGINEERING COMPANY, BOSTON, MASS., ENGINEERS

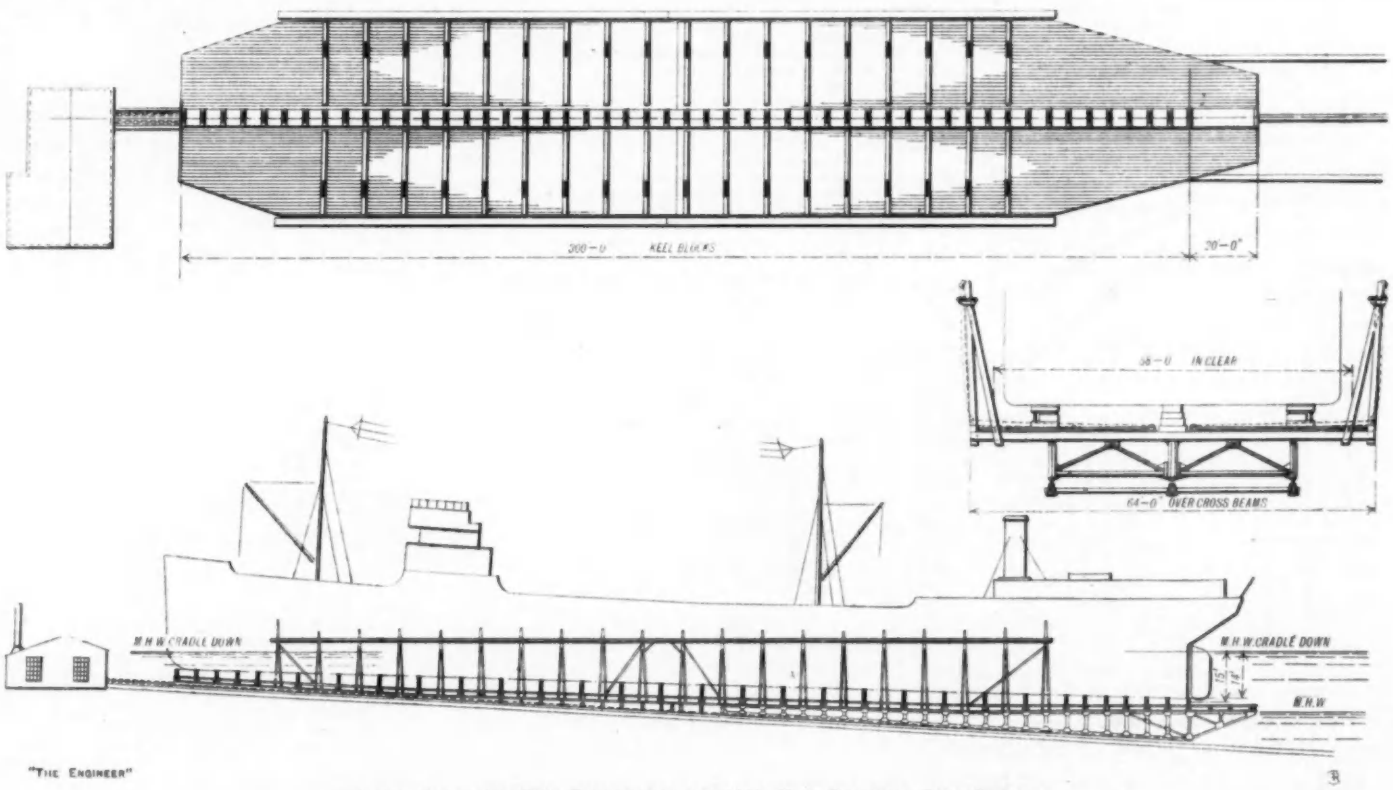


2100-Ton Slipway at Aruba, Dutch West Indies.

DURING the last decade the petroleum industry has been becoming an important element in the life of the Dutch West Indies, until to-day it is in a commanding position. A subsidiary of the Royal Dutch Shell Petroleum Company has established near Curaçao what is one of the largest oil refineries in the world, while the Pan-American Petroleum Company is completing a large refinery on the island of Aruba.

The crude petroleum is transported from Lake Maracaibo to the refineries by small lake tankers, and the importance of dry docking facilities for these vessels is apparent. The Royal Dutch Shell Company maintains a small floating dock at Curaçao for repairing its own tankers, but beyond that there were no other dry docks between Trinidad and Panama, except the two floating docks of the Venezuelan Government at Puerto Cabello. The Lago Oil and Transport Company, Ltd., which operates twenty lake tankers for delivering crude petroleum to the Pan-American Company at St. Nicholas, found it necessary to have its own dry dock in order to save expense and loss of time. After some study it was decided to construct what is called a "railway dry dock" with a lifting capacity of 2100 tons of weight, and it has recently been completed and put in operation at St. Nicholas, Aruba.

This railway dry dock is in fact a type of slipway, as it makes use of the principle of the inclined plane, but the design is carried further than is usual in this country. The tracks, which are of the three-way type, are laid down on a gradient of 1 : 18 and are 604ft. long. The portion of the tracks above water is of reinforced concrete placed directly on a coral rock bottom, while the submerged portion is of



PLAN, SIDE AND END ELEVATIONS OF 2100-TON RAILWAY DRY DOCK

wood supported on wood piling, all protected against marine borers. The cradle is 300ft. long over the keel blocks and 64ft. wide. The slope of the line of keel blocks is quite independent of the gradient of the tracks, being made to suit the usual trim of the tankers giving a depth of water over the keel blocks of 5ft. forward and 15ft. aft at mean high water. The cradle is decked over its entire width for the full length to provide a working platform, and at the aft end this deck extends 20ft. beyond the keel blocks to facilitate repairs to propellers and rudders. There are eighteen sliding bilge blocks on each side of the cradle, which are operated by means of galvanised chains and hand winches arranged on the docking platforms. These docking platforms, which are supported on two-legged uprights, are placed one on each side of the cradle to permit of ready centring and docking. The underframe of the cradle, up to the cross-beams, is of structural steel, the cross-beams and the rest of the superstructure being of wood. The cradle moves over the track on a system of free, flanged rollers, the lower side of the cradle runners and the upper sides of the tracks being equipped with flat steel plates between which the rollers operate. This system reduces the friction and eliminates the necessity for lubrication.

The cradle is hauled by chains on an endless system, operated by a steam hauling machine. The hauling chains, of which there are two, pass over toothed sprocket wheels on the main shaft of the machine, and then back along the track. These chains are of heat-treated manganese cast steel and are without welds. The lower end of each is attached to a smaller backing chain, which passes through a submerged sheave, then returns on itself and the other end fastened to the cradle. The hauling machine is sufficiently powerful to haul a capacity load in 30 minutes and smaller loads in a correspondingly shorter time.

This railway dry dock was designed and constructed by the Crandall Engineering Company, of Boston, Massachusetts, U.S.A. It was completed and the first vessel dry-docked nine months after construction was commenced, and since it has been in almost constant use. It is estimated that it will permit an operating economy of £105,000 a year for the twenty tankers quite apart from any saving in the cost of dry docking and repairs.

CONTRACTS.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., of 82, York-road, King's Cross, London, N. 1, has received from Pearson and Dorman Long, Ltd., an order for all-pneumatic decking plant for the downcast pit at Betteshanger Colliery. The equipment includes rams, kep-operating cylinders, skotch blocks and gates, with the requisite control valves and gear.

NEGRETTI AND ZAMBRA, of 38, Holborn-viaduct, London, E.C. 1, have received from the British Air Ministry an order for 580 of their patented mercury-in-steel distance-reading thermometers for engine-oil temperatures on aircraft. This is the ninth successive order for a total of over 5000 instruments which the British Air Ministry have placed with Negretti and Zambra in the last few years.

NETHERLAND SHIPBUILDING COMPANY (Nederlandsche Scheepsbouw-Maatschappij), of Amsterdam, has contracted with the Koninklijke Paketvaart Maatschappij to build two passenger and cargo steamers, 311ft. 8in. by 46ft. 8in. by 28ft. 11in. and a displacement of 4800 tons. The steam engines, which will be of the poppet valve type and of 1650 I.H.P., will be supplied by Machinefabriek Gebrs. Stork & Co., and the boilers with superheaters will be of the Babcock and Wilcox type.

JOHN FOWLER AND CO. (LEEDS), Ltd., of Leeds, have just received an order for a new fire-box for a narrow-gauge tank locomotive which was supplied in the year 1872. In connection with this order, the Chief Inspecting Engineer of the Egyptian Government writes as follows:—"I do not recollect in all my experience, ever having been asked to obtain a fire-box for a locomotive which has been in service for something like 58 years. . . . It seems to me that it is a very good demonstration of what is meant by Quality in British Goods."

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., has received an order for the complete machinery and plant for the new Montevideo State Electric Super Power Station. The order comprises two 25,000 kW, 3000 r.p.m., turbo-generator sets, each with direct-coupled exciter and 750 kW auxiliary alternator; central flow condensing plant, with motor-driven circulating and extraction pumps and air ejectors; a 750 kW geared turbo-alternator; water-tube boiler equipment, pipe work and valves; complete switchgear and accessories; 7400 kW of three-phase station auxiliary transformers; accumulators and charging equipment, cable work and automatic telephone equipment. The contract runs into nearly three-quarters of a million pounds.

INTERNATIONAL COMBUSTION, Ltd., asks us to announce that its associated company, La Société Anonyme des Foyers Automatiques of Paris, has received an order for three steam generators of the "Wood" type for the Quaregnon Power Station. These generators are to have an evaporative capacity of from 190,000 lb. to 225,000 lb. per hour at 950 lb. pressure and 840 deg. Fah. final temperature, and will normally be fired with pulverised coal, but provision will be made for using as fuel de-hydrogenated coke oven gas. The same firm has also received an order for one steam generator of a similar design, evaporating 80,000 lb. to 90,000 lb. per hour at a pressure of 400 lb. per square inch and a final temperature of 800 deg. Fah. This unit, which will also be fired with pulverised fuel, is intended for the Hensies Pommeroeul Collieries.

CALENDARS, DIARIES, &c.

CROMPTON-PARKINSON, Ltd., Bush House, Aldwych, W.C. 2, refill for desk diary.

A. L. CURTIS, Westmoor Laboratory, Chatteris, England, wall calendar with daily tear-off sheets.

JOHN JONES AND SONS, Ltd., Britannia Ironworks, Loughborough, wall calendar with monthly tear-off sheets.

KENRICK AND JEFFERSON, Ltd., West Bromwich, desk calendar with daily tear-off slips.

MOSS GEAR COMPANY, Ltd., Crown Works, Tyburn, Birmingham, daily engagement pad.

WELBECSON PRESS, Ltd., 108–110, Clarendon-road, Holland Park, W. 11.—Wall calendar with monthly tear-off slips.

R. WHITE AND SON, Ltd., Widnes.—Pocket diary.

W. H. WILLCOX AND CO., Ltd., 38, Southwark-street, S.E. 1, wall calendar with monthly tear-off slips.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Conditions Unchanged.

BUSINESS in iron and steel in the Midlands and Staffordshire continues on a meagre scale. There has been no recent movement of prices and the reaffirming of selling rates of Midland pig irons has not resulted in any increase of interest in this branch. Most of the Derbyshire and Northamptonshire blast-furnaces are disposing of the whole of their output and have some good orders on their books. Steel mills, though not so well placed, have a moderate amount of work on hand, but specifications are not really so good as is wished for. They appear to have fallen away further during the past week. The trouble is that works managements are unable to see far ahead and there is little to stimulate confidence. At the weekly meeting of the iron trade in Birmingham to-day—Thursday—there was only a fair attendance and little business was transacted. The further reduction in the bank rate is encouraging. It will be particularly welcome to some seasonal trades, and should help to stimulate consumptive demand in other directions.

Raw Iron.

Midland blast-furnacemen continue to hold a relatively strong position. They are steadily employed, and while it is stated that specifications are not coming forward as freely as they were, and while also it is admitted that current buying is decidedly slack, smelters have no qualms as to the immediate future. There is no superabundance of those grades of iron which enter most largely into foundry practice. Some of the most important batteries of blast-furnaces are worked in conjunction with pipe foundries, and there are large contracts under execution in that department. All the available output of many of the furnaces has been sold for months ahead. The position of smelters who depend principally on the engineering foundries and the light castings trade is not so secure, but they should be able to carry on comfortably until the spring demand develops. Moreover, there is every prospect of selling prices remaining satisfactory, since the minimum rates are now fixed by the Association and are being rigidly adhered to. The prospects of cheaper coke are also favourable to furnacemen, so that, taken on the whole, they are particularly well favoured just now. On 'Change in Birmingham this week quiet conditions ruled. No. 3 foundry iron was in fair request, but other foundry numbers and forge qualities were in smaller call. In the Black Country area activity at some of the foundries is broken and new orders are needed. Business is slack at the forges and little material is being consumed. The present selling rates for foundry material stand at £3 15s. for Northamptonshire No. 3, and £3 18s. 6d. for Derbyshire, and North Staffordshire forge iron is 4s. less in each case.

Steel.

The heavy steel works are having some difficulty in keeping the rolling mills going, and they have this week been pressing their customers for specifications. Structural engineers and other consumers of this class of material are, however, short of work themselves and are unable, for the most part, to respond to producers' requests. It is true that certain steel products are in moderately good call just now, and also that most works have a certain volume of orders to execute, but trade is not well diffused, and at quite a large number of local establishments there are indications of a slowing down of activity. Demand for finished steel has not been really bright for some time past, but February has witnessed quieter buying conditions in this branch of the steel trade. Values have undergone no change. A large proportion of the business in small steel continues to be taken by the foreigner. Staffordshire re-rollers offer supplies at round about £8 per ton, but find few purchasers, though steel bars are largely used locally. Continental bars are £5 5s. Antwerp or £6 6s. 6d. delivered, leaving a big margin between native and foreign material. Makers of mild steel billets in this neighbourhood continue to quote £6 2s. 6d. upwards. Many of them want at least £6 5s. Foreign billets are procurable at £5 10s. 6d. Despite these low prices present trading between the Midlands and the Continent is lifeless. Users are fully covered for the time being and the outlook is not sufficiently clear to act as an inducement to forward contracting. Birmingham merchants handling steel scrap report a very dull market. The majority of them refuse to give way on the question of values, and quotations are maintained on last week's level. South Wales works consumption is not up to normal and stocks at these establishments are being depleted only slowly.

Finished Iron.

The iron trade in this district maintains its position, but no real headway is being made. Marked bars continue at £12 10s., and this is the most active department of the Staffordshire finished iron trade. Orders are received with fair regularity, and though they are small in size, they enable mills to continue full employment. Crown bars vary between £10 and £10 10s. according to grade, and competition from outside makers has not relaxed. Nut and bolt and fencing iron costs £9 upwards, a price which is ineffective against continental competition. There is very little business being done in continental material The foreign makers are dissatisfied with export prices generally and have called another meeting of the Cartel with a view to enlarging the list of products for which minimum prices have been fixed. It is believed that No. 3 Belgian iron, now selling at about £6 2s. 6d. to nut and bolt makers in the Black Country, is likely to come under this regulation. Staffordshire ironmasters complain of the dearness of pig iron. They are unable to compensate themselves for the heavier outlay of raw materials owing to keen competition and a hesitating demand for the finished article. Though no concerted action has been taken ironmasters are endeavouring to persuade smelters that selling rates of pig are too high. Wrought iron gas tube strip sells steadily at £11 2s. 6d. Producers show no inclination to reduce prices at this stage, being of opinion that no compensating increase in demand would follow such action.

Galvanised Sheets.

Manufacturers of galvanised sheets are thankful that they have, apparently, stopped the rapid depreciation of prices, though they are still without the reinvigoration of demand upon which stability depends. Sheets have sold rather better this past week, chiefly for export to South America and the West Indies. Nevertheless, the volume of business is not sufficient to tighten up prices. Manufacturers who have no adequate orders to keep mills running are not turning away offers of slightly below £11 15s. per ton, but that remains the general quotation for 24-gauge galvanised corrugated sheets.

Midland Wages Board.

The bi-monthly ascertainment of the Midland Iron and Steel Wages Board under the sliding scale for the regulation of ironworkers' wages shows that in November and December the average selling price advanced 1s. 1d. Wages will be unchanged at 30 per cent. above the basis rate of 13s. 6d. The previous ascertainment gave the workers an advance of 2½ per cent. The final output figures for the nineteen firms on whose trading the scale is based brought the production for the year up to 149,898 tons, against 82,425 tons in 1928. Last year's turnover was the biggest since 1924, when the iron and steel sold under the classification was 153,476 tons.

Rail Contracts.

The Metropolitan-Cammell Carriage, Wagon and Finance Company, Ltd., of Birmingham and Nottingham, has been given an order by the London and North-Eastern Railway for fifty 40-ton plate wagons and twenty-five 50-ton bogie wagons. The Sentinel Waggon Works, Ltd., of Shrewsbury, is to supply the London, Midland and Scottish Railway with four 100 H.P. double-geared shunting locomotives.

Edge Tools.

Midland manufacturers of edge tools complain that business is below normal for the time of the year. Normally works should now be busily engaged on tools required the world over for the planting season in the spring, but orders up to now have been substantially below expectations. Most of the firms are able to keep going, having a fair amount of small orders, but the demand is dull when compared with that of other years. The South American market and Brazil are reported to be listless, but the Eastern position has shown a little improvement lately. Australasian markets are fairly good, though bulk orders are not numerous. The home trade in gardening implements is reported as being fair to moderate.

The Chain Trade.

The chain trade in the Cradley district of the Black Country has, I am glad to be able to relate, shown a slight improvement since the opening of the year. This industry has been dull for the last two or three years, owing in a large measure no doubt to the condition of the shipbuilding industry. The demand for the general engineering trades has also been poor, particularly for colliery cables and crane chains, but the fortunes of the trade have always been closely allied to the shipping industry. The smaller factories hereabouts have felt severely the depressed conditions which have ruled in the shipyards, trade in the cheaper grade of chain having been heavily affected by foreign competition. The larger firms, which are chiefly engaged in the production of superior qualities of chain, have not been so badly affected. Sling chains for engineering and the better qualities of short-link chain have been and are in fairly good demand. There is still a large number of unemployed chainmakers in this area.

Bilston Workers' Protest.

Twelve employees of the firm of Dawkins Light Castings, Ltd., Bilston, Staffordshire, chosen by their fellow workmen and accompanied by Mr. Dawkins, have just journeyed by motor lorry to London to register with the Board of Trade a protest against the alleged dumping of German baths into this country. It is claimed that last year nearly 68,000 baths were dumped into this country from Germany at 10s. each cheaper than they could be marketed by the British producers. This resulted, it is stated, in the suspension of about 200 employees of Messrs. Dawkins and the throwing out of employment of about 2000 workers engaged in the manufacture of baths and subsidiary trades in various parts of the Midlands and the North, to which districts the industry is largely confined.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Helping the County.

THE depression through which the Lancashire cotton trade has passed, a depression which is still dogging it, has its effect over a vastly wider industrial area than the cotton mills themselves. Lancashire engineers generally and textile machinists in particular would be able to tell a much more cheerful story to-day if the cotton mills were running anything like full time. Unusual interest attaches, therefore, to the Cotton Fair, which opened here on Tuesday of this week, and which will remain open until March 1st. The attempts that are being made to bring back cotton fabrics into favour should have some influence on the home market for these goods, though the view taken in some quarters is that much more good would result from Lancashire Cotton Fairs held in important overseas markets like India and China. The Manchester

effort, however, has many well-wishers and active support has been forthcoming from makers of textile plant. Among new machinery exhibited are carding engines, ring spinning frames, combing machinery, automatic looms, and winding and finishing plant, most of them products of North of England engineers.

Preston's £127,000 Aqueduct.

Preston Town Council at its meeting on Monday approved the scheme for the new aqueduct, the cost of which is estimated at £127,500. Towards the interest on this sum, the Government has promised a grant of 50 per cent. for a period of fifteen years. A Glasgow tender of £55,649 for the supply of steel pipes in connection with the scheme was accepted, an amendment to refer the question back for further consideration being out-voted.

Additions to Order Books.

Among contracts recently secured by British Insulated Cables, Ltd., of Prescot, is one valued at about £250,000 for the supply and laying of 66,000-volt cables for one of the large London power companies. British Insulated Cables has also secured the contract for supplying and laying the new trunk telephone cable from Manchester to Chester, a distance of about 42 miles. Other important cable orders placed with the company include 96,000 yards of underground cable for Shanghai, and 20,000 yards of underground cable for Australia. The Southern Railway has also placed an order with the Prescot firm for 40,000 rail bonds. Nearly £750,000 is involved in a contract for power station plant for Monte Video, which has been placed with the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, the order including two 25,000-kW turbo-generator sets, condensing plant, a 750-kW turbo-alternator, water-tube boiler plant, and other equipment and accessories.

To the Outskirts.

Simon-Carves, Ltd., engineers, of Mount-street, Manchester, the site of whose premises will eventually be included in the important Midland Hotel extension scheme, has decided in due course to move its headquarters to Cheadle Heath, on the Cheshire side of Manchester, where Henry Simon, Ltd., an associated company, has been established for some years.

Current by Slot Meter.

That there is a growing demand for the installation of slot meters for the supply of electricity was admitted by Alderman Walker, the Chairman of the Manchester Corporation Electricity Committee, at the last meeting of the City Council, when a proposal was put forward that the system should be adopted in Manchester. Alderman Walker said that he was prepared to go into the whole matter again with the chief engineer, and see what could be done. He insisted that if the proposal were adopted it would mean that one section of the public would be receiving current at less than cost price and that the difference would have to be met by someone else. As much as 84 per cent. of the cost of supply was, he said, on account of distributing charges, and unless consumers paid a minimum charge, which was fixed to cover the cost of taking the electricity to their houses, a serious loss was entailed. If the slot meter system was introduced without some special charge to cover the cost of distribution, there might be a heavy loss, due to people using an insufficient amount of current.

Non-ferrous Metals.

Firmness in the copper section has been a marked feature of trade in the non-ferrous metals during the past week. Stocks of refined and standard descriptions of the metal in this country continue to show a declining tendency, with the inevitable reaction on the price situation. There has been a fair movement of standard brands during the week, and some buying of manufactured metal by the cable-making industry at a range of prices on a somewhat higher level than before. With regard to tin, trade has been on narrow lines, and there is no indication as yet that consumers are prepared to depart from the policy of caution which has characteried their buying movements for some time now. In the early days of the present week quotations for the metal slumped to the extent of nearly 30s. a ton, compared with those ruling last week-end. Spelter users are doing little more than covering early requirements, and prices in this section have lost ground a little. There has been a fair demand about in the case of lead, and on balance there has been little change in prices, although signs of reaction, due to less restricted offers of forward metal, have not been wanting during the week.

Iron and Steel.

The iron and steel markets in this area are mostly featureless, and surprisingly little in the way of development has to be reported. Pig iron supplies are being steadily called for on the whole, but users are doing very little at the moment so far as forward buying operations are concerned. Prices are steady, however, at 77s. per ton for Staffordshire and Derbyshire No. 3, about 95s. for Scotch brands, and 92s. for West Coast hematite iron, including delivery equal to Manchester in each instance. A quiet trade is passing in bar iron at £10 15s. per ton for Lancashire Crown quality bars, and £9 15s. for seconds. Constructional engineers are placing little new business in steel sections, and in the aggregate only moderate deliveries are being taken against contracts. As to prospects in this branch, the present lack of important inquiries is encouraging a somewhat gloomy view of immediate prospects. Specifications for locomotive plates are of fair extent, although actual new bookings are slow, whilst general plates and bars, with the exception of bright drawing qualities, are attracting relatively little attention at the moment.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade continues to be firm, and makers are well situated with the present number of furnaces in blast. This district is quite capable of a bigger output should the demand necessitate it. Steel, taking everything into account, the position, comparatively speaking, is fairly good, and the outlook is none too bad. One sign of the steady demand is the tendency for prices to be a little firmer. Makers would not stiffen their prices on a market which had a tendency to fall off. The home demand is steady, and the continental and American business continues. The demands on local steel account continue to be steady, and this is a factor in the present condition of the market. Native ores continue in steady demand, and apart from local requirements outside business is fairly good. The Hodbarrow mines should be turning out more ore shortly, as water in one of the pits has now been stopped. The steel trade continues fair, and both Barrow and Workington are engaged on railway material, and are likely to be busy for some time on present contracts.

SHEFFIELD.

(From our own Correspondent.)

Record Steel Production.

THE Sheffield area last year had the largest steel production ever recorded, its output reaching the total of 1,219,300 tons. The figure is very favourable when compared with the 878,700 tons of 1913, the last pre-war year. In Lincolnshire, the production was 738,400 tons, compared with 533,000 tons in 1928, and only 241,300 tons in 1913. Both areas showed a falling off in December. In that month the Sheffield district turned out only 79,000 tons, which was much below the 101,400 tons of November, and not much better than the 76,900 tons of December, 1928. Lincolnshire's December figure was 57,400 tons, which was nearly 13,000 tons less than that of November, but 16,000 tons more than that of December, 1928. In December, Lincolnshire produced 72,000 tons of pig iron, compared with 63,500 tons in November, and 63,000 tons in December, 1928.

An Unsatisfactory Position.

The declining tendency shown in Sheffield in December has not been reversed, and the present position is unsatisfactory. Only about half the open-hearth furnaces in the district are in operation, and while the trade in basic steel keeps up fairly well, the call for the acid variety is very disappointing. There are no signs that the present quiet spell is coming to an end. Until the outlook is more settled consumers will not buy with confidence. There are active conditions at a comparatively small number of works. Many others find it difficult to keep their plants running, and are in danger of having to curtail production. There are numerous inquiries, but they represent little bulk of work. The special departments are still able to give a better account of themselves than those carrying on an ordinary class of trade, but even in some of these conditions are less bright than they have been until recently.

Penistone Steel Works.

The assistance of the Lord Privy Seal and of the local Member of Parliament has been invoked in the interests of the workers who are threatened with displacement by the closing of the Penistone iron and steel works of the English Steel Corporation, but so far nothing definite has happened to clear away the advancing cloud of depression. At the moment the works are still running. The 34in. and 14in. rolling mills and two steam hammers are again in operation this week, providing employment for between 500 and 600 men. There is a feeling that the future is not without hope, and that the works may be put to some other manufacturing purpose which will provide employment for Penistone men. Two representatives of a Sheffield steel firm attended a special meeting of the Penistone Urban Council on Monday, and discussed with them the possibility of acquiring the premises, but there is nothing further to say about that matter at present. The English Steel Corporation has promised that even if a competitor was a potential customer they would not refuse to transfer the works to him on terms to be arranged. It is stated that about twenty of the Penistone employees have been taken on at the Vickers works (Sheffield) of the Corporation and that there is every chance of more being given employment there, and also that openings are to be found at the works of Taylor Bros., Manchester, another branch of the Corporation.

Greek Irrigation.

The Greek Chamber of Deputies has now approved the placing of the order for large irrigation and reclamation works in Thessaly, Epirus and Crete, with the Sheffield firm of Henry Boot and Sons, Ltd. Full details have already been given in THE ENGINEER of the great scheme, the approximate cost of which is at least £6,000,000. Messrs. Boot state that they will now commence a survey in Greece, which will probably last eighteen months or two years. Before that is completed, however, they will start work on various items of the plant required. Messrs. Boot are to have the execution of 60 per cent. of the work in Greece for ten years and the remainder will be undertaken by Greek firms.

Roadmaking.

Sheffield's pioneer work in roadmaking was referred to by Mr. W. J. Hadfield, the City Surveyor, in an address which he gave as president of the University of Sheffield Engineering Society. He said that Sheffield was one of the first places to realise that motor traffic needed something different from the old sett paving. Twenty years ago a policy of laying tar macadam on roads with medium traffic was adopted, and by 1914 a million square yards of that material had been laid. To-day there was far more. Since 1919 more than a million yards of asphalt had been laid, nearly all of the Corporation's own manufacture, and he did not hesitate to say that as a result of Sheffield's enterprise in this direction, its roads were costing less in proportion to their mileage than before the war. The increase in traffic, of course, had been enormous, yet the roads were cheaper, because for twenty years they had been pioneers in new processes. The question of the tar-spraying of roads is causing some concern in mining circles. Wath-on-Dearne Urban Council has decided to write to the West Riding County Council asking for information as to the class of roads considered unsuitable for tar-spraying. Mr. P. B. Nicholson, a prominent member of the Coke Oven Managers' Association, said that the move against tar-spraying handicapped the coal industry. If the example of Sheffield was followed by all local authorities in the country, it would mean a loss of £1,500,000 to the industry. He added that the Sheffield City Surveyor had been unfortunate in his experience of tar.

Tribute to a Leeds Official.

Leeds Corporation has made notable recognition of the services of Mr. C. N. Hefford, the General Manager of the Electricity Department, by granting him a year's salary, in two equal instalments, in acknowledgment of his work in the design, equipment and construction of the Kirkstall generating station. In moving the grant Mr. R. Tortington, chairman of the Electricity Committee, remarked that when the Whitehall-road station was constructed at a cost of £375,000, approximately £19,000 was paid in architect's fees. The cost of the new station would be much greater than that of Whitehall-road, and would have involved a correspondingly higher sum in fees. Alderman Hugh Lupton said anything from £18,000 to £20,000 had been saved in fees. Favourable contracts had been entered into, so much so that the original estimates of cost would not be reached. Mr. Hefford had worked almost night and day for two years.

Road and Bridge Schemes.

Nottinghamshire County Council, which has before it a five years' programme of work for the relief of the unemployed—involving a total expenditure of £1,000,000—last week approved part of it, to cost £308,000. The work consists principally of the widening of roads and bridges. Bradford Corporation has obtained the sanction of the Ministry of Transport, subject to certain minor modifications, to road schemes for the relief of the unemployed, the total cost of which is estimated at £403,000. A new bridge is to be thrown across the river Aire at Apperley Bridge, with approaches on each side of the river. The West Riding County Council is partner with Bradford in this scheme, and Bradford's share of the cost will be £40,000. A new road is to be made from Nelson-street to Rooley-lane and Park Side-road, at a cost of £70,300. Wakefield Corporation has before it an important scheme for the construction of a new bridge over the river Calder, close to the present Chantry Bridge. The carrying out of the scheme, which has been desired for some time, will be made possible by the County Council's decision last week to purchase from the Aire and Calder Navigation the King's Mill and adjoining property, near the city end of the Chantry Bridge. The new bridge, which will link up Kirkgate, straight across to the roads leading to Doncaster and Sheffield, will probably be 75ft. wide, and its cost will be in the neighbourhood of £50,000. It is anticipated that preliminary work will commence almost immediately, and that the bridge will be completed within about two years.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Shipbuilding Orders.

ORDERS for new vessels are still being placed with North-East Coast builders. This week Hawthorn, Leslie and Co., Ltd., announce an order for a third vessel for the Anglo-Saxon Petroleum Company, Ltd. The vessel is of a special type, and the propelling machinery will consist of an eight-cylinder single-acting Werkspoor Diesel engine, fitted with the Werkspoor supercharging system. The firm has just completed and handed over to the British Admiralty the destroyer "Active." Another destroyer, "Antelope," is nearing completion. The "Active" was laid down on July 11th, 1928. W. Gray and Co., Ltd., West Hartlepool, have booked an order for a cargo vessel of a moderate size for Bergen owners. The builders will also supply the engines for the vessel from their Central Marine Engine Works. Ship-repairers on the North-East Coast have a good deal of work in hand at the present time. Some of it includes lengthening jobs, which will occupy several weeks in completion, and there are several contracts for heavy repairs following collisions. Numerous large cargo liners are undergoing repairs, so there is variety as well as activity at most of the establishments. The new work booked lately has been largely for oil tankers, and mostly for foreign owners. Norway's rapid expansion of her mercantile fleet has created a lot of work for this district. Favourable terms of credit have, of course, entered largely into the transactions.

Cleveland Iron Trade.

The present course of the Cleveland pig iron trade is very disappointing, and is confounding the anticipations that were formed at the beginning of the year. The market still fails to display the least sign of returning animation. Sellers find it increasingly difficult to realise present prices for sales abroad, and exports continue to decline. This decline is reflected also in the home trade. The growing toll of unemployment at home and fears regarding the Budget have created in industrial circles a feeling of uncertainty entirely inimical to business enterprise, and it is ruefully admitted that the fall in the bank rate has entirely failed to counteract these adverse influences. Moreover, the belief persists that pig iron prices will fall. Coke is substantially cheaper, but ironmasters still adhere to the old minimum prices, and as buyers refuse to pay these figures, except for small lots for immediate needs, stocks are increasing and may continue to

increase, seeing that a blast-furnace at the Newport Ironworks, Middlesbrough, has been transferred from hematite to Cleveland iron. No. 1 Cleveland foundry iron is 75s., No. 3 G.M.B. 72s. 6d., No. 4 foundry 71s. 6d., and No. 4 forge 71s.

Hematite Pig Iron.

Comparatively low and unremunerative rates asked for East Coast hematite pig iron fail to attract buyers, who look for a further fall in prices. The normal pre-war difference in values of No. 3 Cleveland and ordinary qualities of hematite was 8s. to 10s., whereas now it is but 5s. 6d. Hematite quotations are not definitely fixed, and terms of contract vary somewhat after individual bargaining, but iron is on offer at the equivalent of 78s. for ordinary descriptions. Cheapness of foreign hematite largely precludes the use of the products of this district in continental areas, and home demand is on only a moderate scale. Producers are loth to make price concessions, but merchants have still possession of rather considerable parcels and are anxious to sell.

Iron-making Materials.

The foreign ore trade is practically at a standstill so far as new business is concerned. Consumers have long contracts against which to draw, and are disinclined to take full deliveries, as they fall due. Blast-furnace coke continues plentiful. Good average descriptions are in the neighbourhood of 21s., delivered at works on the North-East Coast.

Manufactured Iron and Steel.

The manufactured iron and steel trade presents no new features this week. Business rules on very quiet lines, but makers still have a good deal of work in hand. Values are maintained, though keener competition is experienced in some departments.

The Coal Trade.

There is an uncertain outlook in the Northern coal trade. A common feeling is that the briskness of past months is drawing to a close, and that we may soon see a contraction of business. The output is very large, and a big volume of trade will be required to absorb it. The individual position of collieries varies greatly. Some have sold on quite substantial lines to the end of this year, and at prices a full 2s. better than were prevailing twelve months ago. All they desire is to go on steadily producing and delivering without any interference by marketing and quota schemes. Other collieries have not sold very far ahead, and are constantly in need of prompt trade, which throughout last year was the salvation of many a pit and may be again this year. There is a feeling, however, that in the main, the trade is going back, if only slowly at present, and that nothing would be more likely to give it a fillip at the present time than a quick and sustained spell of frost in Northern Europe. The demand from abroad just now is exceptionally limited, and the position is accentuated by the difficulty experienced by contractors in getting clear of their commitments. Concessions are now possible for Northumberland steam coals. In fact, they may now be secured through second-hands at 15s. 3d. to 15s. 6d., while secondary kinds are marked down at 14s. 9d. to 15s. The fact that buyers of large steams have relaxed their demand reacts heavily upon the forward trade in small steams, for producers are not inclined to commit themselves to a delivery of smalls in excess of the prospective output of other descriptions. Under a restricted offer, prices of small, though tending strongly, are remaining at 12s. 6d. for specials, with bests at around 12s. 3d. and seconds 12s. There is no improvement in the Durham position. Large steams are 17s. to 18s., and smalls 14s. to 14s. 6d. The gas coal trade is quiet, with bests at 16s. 6d. to 16s. 9d. Wear specials at 17s. to 17s. 3d., and seconds at 15s. to 15s. 6d. Coking coal cannot make any more than about 15s. 6d. for good unscreened qualities, and 15s. or 15s. 3d. for lesser brands. Ordinary bunkers are obtainable at 15s. 3d., while bests are 16s., with specials ranging to 17s. All descriptions of coke are freely offered, and the demand remains dull. Gas coke is quietly steady at 25s. Patent oven coke is in ample supply and slow demand at 19s. to 21s.

SCOTLAND.

(From our own Correspondent.)

Outlook Improving.

THE completion of arrangements for the renewal of Cartels on the Continent has to some extent cleared the air so far as the steel and iron trades are concerned, and already, it is said, inquiries in some branches are more numerous. Nothing approaching a general increase in trade can be expected for some considerable time, but in some districts certainly the position is very much better than it was twelve months ago, and producers are hopeful that the movement will gradually expand.

Steel.

The demand for heavy steel is steady, though still somewhat below normal. The plants in operation almost succeed in maintaining full time, and inquiries are, if anything, better. Owing to enhanced costs and to the fact that current prices are considered unremunerative, it is expected that at a meeting to be held this week the Steel Cartel will advance maximum prices by at least 2s. 6d. per ton.

Sheets.

Black sheets are comparatively quiet at the moment, though the lighter gauges have fair specifications. Galvanised descriptions, however, are poorly supported, and as low as £12 per ton has been accepted for export for 24-gauge corrugated. The home price is round about £12 5s. per ton.

Tubes.

The renewal by the International Cartel of the export price and quota agreement has been hailed with considerable satisfaction by tube makers, who anticipate that the demand for British manufactured tubes will be greatly stimulated thereby, especially in respect to exports, which have been quiet for some time pending the Cartel's decision.

Iron.

The bar iron industry continues quiet and rollers of steel bars also are in need of fresh orders. The latter are still quoted about £7 12s. 6d. per ton, home or export. A decline in house building activities and continental competition are responsible to a large extent for the decline in the output of light castings.

Pig Iron.

The demand for Scottish pig iron, though steady, is very restricted. The home trade is still affected by imports from India and other countries. Minimum prices are still unchanged, though hardly remunerative.

Scrap.

Business in scrap is rather limited, being mostly for small lots for immediate consumption. Prices as a rule rather favour buyers, with heavy steel at 70s. and cast iron machinery 69s. 3d. per ton.

Coal.

The Scottish collieries, as a rule, find it difficult to maintain the present rate of output owing to the lack of fresh export business and a home demand below normal. A certain amount of idle time is reported, and a further curtailment of the production will probably be necessary. Prices have not been properly tested, but a feeling of weakness is general, the only descriptions of fuel being exempt being Lanarkshire splints, which are well booked up some time ahead, and pearls in all districts. Aggregate shipments amounted to 245,365 tons, against 245,686 tons in the preceding week and 255,385 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Trade Conditions.

NEW features in trade conditions in this district are rather absent at the present time, and yet there is some indication of change. Unfortunately, so far as the ship-repairing industry is concerned, the alteration is not for the better. During the past two months ship-repairers have had quite a good spell, but the acute depression in the shipping industry is beginning to have its effect. Tonnage is being laid up in ever increasing quantities, and quite a number of foreign-owned vessels are being ordered home to lay up after the completion of current voyages. The total number of steamers undergoing repairs in this channel is gradually falling off, and it is not surprising that leading firms of repairers are somewhat apprehensive regarding the near future. In the coal trade it cannot be denied that to all outward appearances the conditions are extremely quiet, and yet the returns of shipments are keeping up well. For instance, the figures issued by the Great Western Company in regard to shipments as cargo and bunkers from the six ports under its control for the week ending the 8th inst. show a total of 644,600 tons, as compared with 580,814 tons for the corresponding period of last year. At the end of last week the total of idle tipping appliances at the various docks was eighteen and only one steamer was waiting, but as the results of arrivals over the week-end, the position was that twelve tips were idle and there were thirteen steamers waiting to berth. It will be seen that, despite the quietness prevailing, there is a fair measure of activity, though there is no real pressure. In fact, a good deal more business is required to impart life to the coal market. A few new orders are coming in for quick shipment, these being induced solely as the result of the cold spell of weather being experienced. A month of real winter weather would make a great difference to this market. There are certainly more inquiries about for supplies of coal and fuel for delivery ahead. In addition to the call for prices for supplies for the French Marine authorities, there are hopes that the order for about 100,000 tons of coal for the Central Railway of Brazil will come to this district, while the Portuguese State Railways are coming into the market at the end of this month for quotations for about 100,000 tons of smalls for delivery, presumably, over the next three months or so.

Shipping.

Is the shipping market on the turn? That is the question that has been asked many times during the past week. The state of shipping is undoubtedly as bad as it can well be, and consequently it is in the nature of things to expect that if it cannot be worse, the chances are that the next movement will be towards improvement. Outward rates of freight for South American destinations have hardened slightly during the past week, for the reason that homeward business is so unremunerative. Tonnage is still being laid up, but, taking the position generally, it can certainly be said that there are not wanting signs of a turn in the outward market. There is, however, no definite jump in actual rates. The advance in rates may not be very much for a time, but it is encouraging to observe that there is a change coming, whereas of late it was impossible for anyone to see the bottom of the market. It looked at one time as if rates would never stop falling.

Tin-plate Industry.

At the present time 57 per cent. of the tin-plate manufacturers in the country are associated with the South Wales Tin-plate Corporation Selling Organisation, but before very long this percentage is to be increased. The report was current last week that agreements had been drawn up between three large tin-plate manufacturing companies in the Swansea district and the South Wales Tin-plate Corporation, which means that before long arrangements will be made for their participation in the pooling scheme which has been of such advantage to the industry. It is understood that the three companies concerned represent about thirty mills. Their names have not been divulged as yet, and, according to a leading authority, it cannot be definitely stated when the agreements will be signed, but it is probable that it will be very soon. When this does take place it will mean that the total number of mills associated with the South Wales Tin-plate Corporation will be brought up to 471.

Dock Charges.

The Cardiff Chamber of Commerce decided on Monday to oppose the Bills which are being promoted by the London and North-Eastern, the London, Midland and Scottish, and the Southern railway companies, the purpose of which is to secure powers to continue existing dock charges indefinitely, subject, of course, to the rights of traders to appeal to the Railway Rates Tribunal. The view prevailed that for the railways to obtain such powers would be a serious disadvantage to traders. If the Bills went through, the result would be that at a later date the Great Western Company would be able to obtain similar powers because of the precedent established.

Current Business.

New business in steam coals for prompt loading is quieter, though a few fresh orders are coming into the market for near continental ports. The collieries continue to feel, however, the inadequate demand, particularly for large coals. Some qualities are so very fully stemmed that it is difficult to obtain supplies for quick shipment, but with the majority of collieries the position is the reverse. Even dry coals have fallen away and like other descriptions are now obtainable at the minimum schedule prices. The tightness of smalls is still pronounced, but sized coals are more irregular. Coke is comparatively quiet and patent fuel is steady, but pitwood meets with a very quiet demand.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING has been moved to 14, Anerley-hill, S.E. 19.

MR. A. C. HARDY asks us to announce that he has moved his aviation interests to 6, Norfolk-street, Strand, W.C. 2, but is keeping his shipping interests and his consulting work at his office at 110, Fenchurch-street.

THE NATIONAL GAS ENGINE COMPANY, Ltd., of Ashton-under-Lyne, asks us to announce that it has taken over from the Keighley Gas and Oil Engine Company, of Keighley, Yorks., the patterns, drawings and records of all engines sold by the latter.

JOHN FOWLER AND CO. (LEEDS), Ltd., of Leeds, have been awarded a Grand Prix for machinery exhibited at the Exposicion Internacional De Barcelona, 1929. The exhibits included a 6-ton motor roller, two concrete mixers and a contractor's winch.

MR. P. H. NYE, of the Shanghai Branch of the General Electric Company of China, Ltd., is returning to England, and Mr. N. G. Beale, who for some years has been chief engineer for the company in China, has been appointed to succeed him as general manager in that territory.

OERLIKON, Ltd., asks to announce that on Monday, February 17th, the address of its offices will be changed from 28–31, Essex-street, Strand, W.C. 2, to Victoria House, Southampton-row, London, W.C. 1. New telephone Nos.: Holborn 0824–0825. Telegrams: Oerlik, Westcent, London.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., asks us to announce that its Liverpool office has been moved from 16, South Castle-street to 27–29, Stanley-street, Liverpool. The telephone number—Bank 5700—and the telegraphic address—"Asteroidal," Liverpool—remain unchanged.

THE GENERAL ELECTRIC COMPANY, Ltd., Magnet House, Kingsway, London, W.C. 2, asks us to announce that it has opened two new branches in India as follows:—The General Electric Company (India), Ltd., 7, Brigade-road, Bangalore, Mysore State; and The General Electric Company (India), Ltd., Main-road, Trivandrum, Travancore State.

MR. S. NICHOLS, who has been for some years manager of the Middlesbrough office of the British Thomson-Houston Company, Ltd., is now relinquishing that position and becoming manager of the company's Liverpool office at 27–29, Stanley-street, Liverpool. Mr. A. D. Mackinnon, for many years a member of the company's Glasgow office staff, has been appointed manager of the company's Middlesbrough office.

FIRE EXTINCTION.—A demonstration of "Phomene" fire extinguishers was made by the Pyrene Company, Ltd., at its new Brentford premises on February 4th, when a fire in a circular tank with an area of 320 square feet was extinguished in just under 1¼ minutes by a single foam jet from a 1½in. nozzle. A cinema projector extinguisher was also demonstrated several times to a large party of visitors.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The annual dinner of the Institution of Electrical Engineers was held at the Hotel Cecil on Thursday, February 6th. The toast "The Institution of Electrical Engineers" was proposed by Sir J. H. Jeans and was responded to by the President, Colonel Sir Thomas F. Purves, who remarked that, whereas other Institutions had adopted the policy of allowing more or less specialised groups of interests to form themselves into separate institutions of scientists with independent constitution and under separate government, they, on the other hand, had thought that a profession which was based on electrical knowledge and research, however wide in its interests, was capable of being treated as one profession, and as far as he was able to judge, the plan was working well. In referring to the rapidity with which new and wonderful scientific inventions were regarded by the public as commonplace, Sir Thomas remarked that he was told that in Pennsylvania there was a shop that bore the sign "Ye Old Radio House." No generation had witnessed such scientific progress as had been unfolded in the last thirty or forty years. The toast of "Our Guests" was proposed by Captain J. M. Donaldson and should have been responded to in part by Mr. H. B. Lees Smith, the Postmaster-General. In a letter explaining his unavoidable absence read by Sir John R. Brook, Mr. Lees Smith said that the Post Office employed 32,000 men in its engineering department alone, and that it had developed the telephone and wireless services to the stage that any telephone subscriber could now get into touch with 90 per cent. of the subscribers in the world.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 21/–
(1) Spanish	21/6 to 23/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 1 0	—
No. 1 Foundry	4 0 6	—
No. 3 Foundry	3 18 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 18 0	3 18 0
No. 1	3 18 6	3 18 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 15 6	—
„ „ Foundry	3 19 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Forge	3 11 0	—
(1) Derbyshire—		
No. 3 Foundry	3 18 6	—
Forge	3 14 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 13 6	—
No. 4 Forge	3 9 6	—
Basic	—	—
(4) N.W. COAST— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 9 6 (*a*); 4 11 6 (*b*); 4 15 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	12 5 0	12 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	10 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 15 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	8 0 0 to 8 15 0	—
Billets and Sheet Bars	6 2 6 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	11 15 0 to 12 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/6 to 18/9
Block Tin (Cash)	174 16 0
„ (three months)	177 15 0
Copper (cash)	74 12 6
„ (three months)	69 17 6
Spanish Lead (cash)	21 12 6
„ „ (three months)	21 12 6
Spelter (cash)	19 12 6
„ (three months)	20 5 0
MANCHESTER—	
Copper, Best Selected Ingots	79 10 0
„ Electrolytic	84 10 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	23 2 6
„ Foreign	21 12 6
Spelter	20 5 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

Tungsten Metal Powder	3/4½ per lb.	
Ferro Tungsten	3/1½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 7 6	7/6
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 10 0	10/–
„ „ „ 1 p.c. carbon	£39 0 0	15/–
„ „ „ 0·70 p.c. carbon	£41 10 0	15/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
„ „ 75 p.c.	£19 0 0 scale 7/– per unit	
„ Vanadium	12/10 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/–
„ „ Ell	16/–
„ „ Splint	16/6 to 18/–
„ „ Trebles	14/6
„ „ Doubles	13/– to 13/6
„ „ Singles	13/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/–
„ „ Jewel	17/6
„ „ Trebles	14/6
FIFESHIRE—	
f.o.b. Methil or Burnt-island—Steam	12/6 to 14/6
Screened Navigation	18/– to 19/6
Trebles	14/– to 14/6
Doubles	13/–
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/–
Secondary Steam	13/6
Trebles	14/6
Doubles	12/9
Singles	13/6

ENGLAND.

(8) N.W. COAST—	
Steams	21/6 to 22/–
Household	38/– to 51/–
Coke	26/–
NORTHUMBERLAND—	
Best Steams	15/6 to 16/–
Second Steams	15/–
Steam Smalls	11/–
Unscreened	13/– to 13/6
Household	25/– to 37/–
DURHAM—	
Best Gas	16/6 to 16/9
Second	15/3 to 15/6
Household	25/– to 37/–
Foundry Coke	25/– to 30/–

SHEFFIELD—	Inland.	
Best Hand-picked Branch	26/6 to 28/–	—
Derbyshire Best Bright House	21/– to 23/–	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	18/6 to 20/–	—
„ „ Nuts	16/6 to 18/–	—
Yorkshire Hards	15/6 to 17/–	—
Derbyshire Hards	15/6 to 17/–	—
Rough Slacks	9/– to 10/–	—
Nutty Slacks	7/6 to 8/6	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	17/– on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.	21/6 to 23/–	

CARDIFF— (9) SOUTH WALES.

Steam Coals :	
Best Smokeless Large	20/– to 20/3
Second Smokeless Large	18/9 to 20/–
Best Dry Large	19/– to 19/6
Ordinary Dry Large	18/6 to 18/9
Best Black Vein Large	18/6 to 18/9
Western Valley Large	18/3 to 18/6
Best Eastern Valley Large	18/– to 18/3
Ordinary Eastern Valley Large	17/9 to 18/–
Best Steam Smalls	14/9 to 15/–
Ordinary Smalls	13/6 to 14/6
Washed Nuts	19/6 to 28/–
No. 3 Rhondda Large	21/– to 21/6
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	16/– to 16/6
„ „ Smalls	15/– to 15/6
Foundry Coke (Export)	32/6 to 37/–
Furnace Coke (Export)	27/– to 28/–
Patent Fuel	22/– to 22/6
Pitwood (ex ship)	25/9 to 26/3
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/– to 38/–
Seconds	30/– to 32/6
Red Vein	26/– to 28/–
Machine-made Cobbles	42/6 to 45/–
Nuts	45/– to 46/6
Beans	25/6 to 28/–
Peas	20/– to 20/6
Breaker Duff	10/9 to 11/3
Rubbly Culm	12/– to 12/9
Steam Coals :	
Large	20/– to 21/–
Seconds	18/6 to 19/6
Smalls	13/6 to 15/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

Industrial Outlook.

THERE are two elements of uncertainty in the industrial situation, one being the growing difficulties in the way of carrying out public works and the other the steady rise in production costs. So far, the activity in the execution of public undertakings has been mainly responsible for the country's industrial prosperity, and it has only been possible with the aid of German reparations, which permitted of more work being accomplished during the past few years than in any previous similar period. Now that the German participation has been considerably reduced, the State is obliged to provide for the deficiency, if it can, and the different public interests which are taking stock of the situation are not satisfied with the outlook. The Association des Grands Ports Français finds that the resources available will only allow of one-half of the programme of ports extensions and equipments being carried out. It is, therefore, looking to the State for aid. As with everything else, the estimated cost of the undertakings is likely to be exceeded by the increasing charges of all kinds and by the organised production whereby output will be more or less adapted to requirements, and prices will be kept at a more remunerative level. Manufacturers feel that they are not being fairly dealt with, for, after supporting exceptional charges during a period of prosperity, when they could bear them in order to relieve the national finances, they expected that those charges would be reduced as soon a there was no longer the same need for them. The situation being now less satisfactory, the burden has become serious, and to it is to be added the further contribution imposed by the social insurance scheme. There is a firm belief that this further call on them will increase costs still more at a time when there is obviously every necessity to reduce them. The falling off in the export trade and the diminishing home consumption are factors that cannot be ignored, and, although the situation generally is still good, there is, nevertheless, a slowing down generally, and it is felt that, at this moment, industry needs all the relief that it can get.

The Motor Industry.

There is much dissatisfaction in the motor car industry all over the Continent. So far, it has been accepted as an article of commercial faith that the only way to widen the demand for cars is to bring down prices by mass production, and that has been accomplished with some success, but the process has been carried so far that the acceleration of buying appears to be slowing down. It is now seen that there is a limit to the market's power of absorption. There is still much to be done, particularly in commercial vehicles, and makers in continental countries feel that they must keep those requirements to themselves. They, therefore, express some resentment at the way in which United States' manufacturers have organised sales of cars on this side, to the extent that, despite the *ad valorem* duty of 45 per cent. on vehicles coming into France, they sent into this country last year 17,000 cars. The proposed readjustment of duties whereby they will be increased to an appreciable extent is arousing considerable protest in the United States, where measures of retaliation are threatened; but the French ask in what way it is possible for America to retaliate when the prohibitive duties in that country make it almost impossible for the French to do any trade at all. While American manufacturers are protesting against the new import duties, it is affirmed that the great American corporation which purchased the Opel works, and became the largest producer of cars in Germany, is supporting the movement in that country in favour of excluding foreign vehicles. The same thing has happened in France, where certain industries are controlled by American capital. The French fear more the effects of the invasion of foreign capital in industrial undertakings than they do the importation of foreign goods.

Coal.

The production of the French collieries during 1929 was 54,921,850 tons, an increase of nearly two and a-half million tons on the previous year. A growing consumption reduced the stocks that had accumulated at the collieriés, and the coal imports amounted to 23,657,188 tons. As German reparation coal was reduced towards the end of the year, it is fairly certain that the increase was due largely to British fuel. The coalowners have been very successful in adapting the industry to the special conditions under which it exists. They have to meet severe competition from Belgium as well as from Germany, and they are unfavourably situated for the distribution of coal. They have entirely failed to displace British coal on the Atlantic seaboard, but have, nevertheless, made the industry prosperous by effecting economies with the modern plants that were installed at the time of the reconstruction, while they are continually augmenting the coke production and have put down new electrical power stations for using pulverised coal. The scheme for laying a high-pressure gas main from the Lens colliery to Paris is under serious consideration and will almost certainly be put in hand eventually. At the same time, interesting experiments are being carried out in the way of utilising the by-products of carbonisation, but there is nothing yet to show that the production of alcohol and oils can be made commercially successful.

Concrete Bridge.

What is believed to be the longest single-span concrete bridge is that which has been constructed across a ravine for the road between Annecy and Saint-Julien in the Haute-Savoie. The ravine has a depth of 150 m. The length of the arch is 137·5 m., and the roadway is suspended by hollow rectangular pillars 6 m. by 1 m. 20 section, there being five of them on each side. To serve as a foundation for the construction of the bridge, four parallel wood arches were thrown across the ravine to support the platform. More than three years were occupied in the construction of the bridge, which recently underwent its official tests with entire success.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

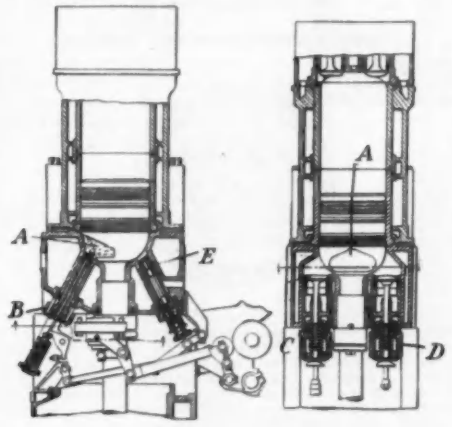
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

323,691. March 22nd, 1929.—IMPROVEMENTS IN DIESEL ENGINES, *W. W. Trigg*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

This invention concerns the double-acting four-stroke cycle type of Diesel engine. In it the piston is so shaped that it closely

Nº323,691



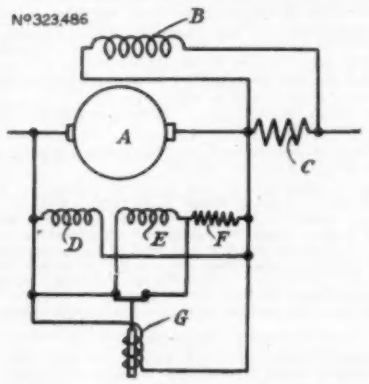
conforms to the shape of the bottom cylinder cover except for the "arcuate recess" A, which faces the fuel injection valve B. This recess, together with the pockets above the air admission valve C and the exhaust valve D, provide the whole of the combustion space. The air starting valve is shown at E. The remainder of the engine is normal.—*January 9th*, 1930.

DYNAMOS AND MOTORS.

323,486. October 1st, 1928.—CONTROL SYSTEMS OF ELECTRIC MACHINES, Leonard Miller, of "Redcot," Ellesmere-road South, Chorlton-cum-Hardy, Manchester; Charles Filmer, of 55, Ashfield-road, Altrincham, Cheshire, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

This invention relates to control systems of electric machines, and in particular to constant current variable voltage systems in which motors are connected in series with the generator, which is arranged to give a constant current supply. A motor armature A, having a field winding B, is connected in series with a generator (not shown) giving a constant current supply. The series field winding B is permanently shunted by a resistance C to provide a constant main excitation. The motor A has two similar auxiliary field windings D and E adapted to oppose the main field. The winding D is permanently connected across the armature. The winding E is connected across the armature, but is arranged to be normally short-circuited by a fluttering relay G, which is biassed to close and has its operating coil connected across the armature. An auxiliary resistance F is provided in series with the winding E to prevent the arma-

Nº323,486

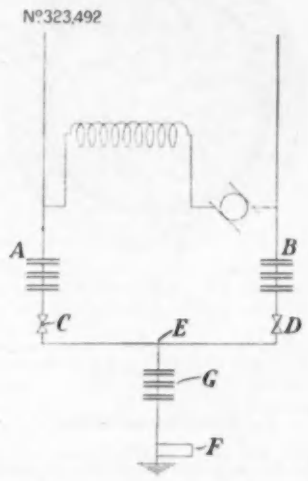


ture being short-circuited when the relay is closed. In an equivalent arrangement the respective positions of the contacts of the fluttering relay G and of the resistance F can be interchanged, the relay being biassed to open so that the resistance absorbs the inductive discharge of the winding E. The steady field strength due to the main field winding B by reason of the auxiliary windings D and E and the relay G, will be reduced upon an increase of the voltage across the armature, being brought down to a particular value at a lower voltage when the relay is actuated than when it is not actuated. The speed of the motor A will be proportional to the voltage divided by the field strength. The motor will start up with the field winding E unexcited and, if the load is sufficiently light for the motor speed to rise to a value such that the motor armature voltage attains a value at which the relay G is set to operate, the latter will operate to introduce the field winding E, thus causing a reduction in the torque of the motor. At the same time the voltage will fall so that the relay will tend to cut out the winding again. Thus the relay will tend to hold the armature voltage in the neighbourhood of the predetermined value and maintain a torque appropriate to the load at the speed at which the motor is running.—*January 1st*, 1930.

323,492. September 27th, 1928.—AN APPARATUS TO PREVENT THE RADIATION OF OSCILLATIONS FROM DYNAMOS, MOTORS AND THE LIKE MACHINES, Theodore Dickinson, of Tides Reach, South Sands, Salcombe, Devon.

The object of this invention is to prevent the radiation of electrical oscillations from all electrical machinery, such as dynamos, motors, electric sweepers and other machines. The drawing shows the application of the invention to a shunt

Nº323,492

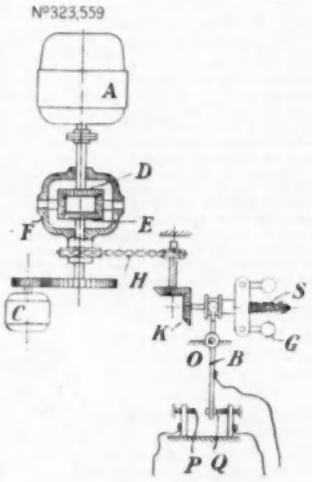


wound dynamo. Two condensers A and B of sufficient and the same capacity are interposed between the terminals of the machine, and two small fuses C and D of about 250 milliamps each are connected in the circuit. The condenser circuit is closed at a point E midway between the two small fuses, to which point the frame of the machine F is connected to earth through a third condenser G of the same capacity as the condensers A and B.—*December 27th*, 1929.

323,559. October 9th, 1928.—DEVICES FOR CONTROLLING ELECTRIC CIRCUITS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2, and Ralph David Given, of 10, East Newbold-terrace, Leamington Spa, Warwick.

This invention relates to electric control systems, and more particularly to systems in which it is necessary to cause a relay to operate when the speed of a motor is reduced to zero or some predetermined low value. Referring to the drawing, A is the motor on the reduction of the speed of which the arm B constituting the relay switch is required to operate. C is a constant speed motor, and a train of differential gearing is connected between A and C. The rotor shaft of the motor A drives the wheel D, and the motor drives the wheel E of the differential gear through

Nº323,559



reduction gear. The wheels D and E are driven in opposite directions, so that at one particular speed of the motor A the casing F of the differential gear—shown partly in section—is at rest. When, however, the speed of motor A is reduced, the casing F acquires a corresponding speed of rotation, thereby driving the centrifugal governor G, the drive illustrated being by a chain wheel on the casing driving by chain H the bevel gears K. When the speed of the governor has reached a definite value, the force of its spring S is overcome and the lever B is moved about its pivot O, so that the electrical contacts at Q are broken and, if required, contact is made at P. By means of the circuits at P and Q, the desired control, such as the opening of a circuit breaker in the circuit of the motor A is accomplished.—*January 9th*, 1930.

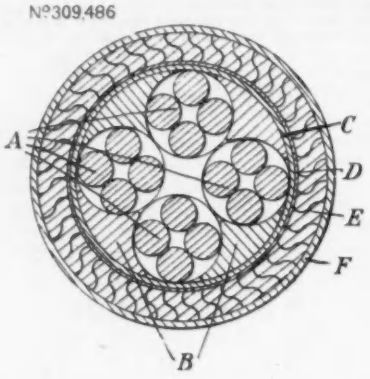
TELEGRAPHS AND TELEPHONES.

309,486. March 12th, 1929.—SUBMARINE CABLES, Felten and Guilleaume Carlswerk Actien-Gesellschaft, of Köln-Mulheim, Germany.

In submarine cables having a paper and air space insulation and intended to be laid at great depths, it has been proposed to support the lead sheath against the water pressure by a tubular structure lying under it and composed of inter-engaging section wires laid around the cable core. While such an arrangement provides the desired effect of a protection of the lead sheath against deformation and a protection of the cable core against dangerous pressures, it has one disadvantage. When the protective section wires are laid directly over the cable core, the core is exposed to the action of the atmosphere both during the application of the protective cover and also before the outer lead sheath is applied, and absorbs moisture, which, as is well known, results in a deterioration of the electric properties of the insulation. For preventing damage to the inner covering when applying the tubular pressure-resisting covering, according to the present invention, a pad of jute or some other material suitable for this purpose is applied over the inner covering. The accompanying drawing shows a constructional example of

the submarine cable according to the invention, in cross-section. A are four stranded quads, B the filling pieces added to the cable core, C is the covering for protecting the cable core against

N°309,486



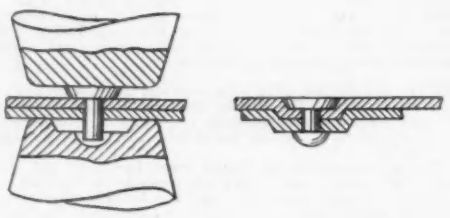
moisture, D a jute pad, E the pressure-resisting casing, and F the outer lead sheath, over which an armouring may be applied in a known manner.—*January 2nd*, 1930.

MISCELLANEOUS

323,446. May 6th, 1929.—RIVETED JOINTS, De Bergue and Co., Ltd., Strangeways Ironworks, Strangeways, Manchester.

This invention is obviously concerned with the riveting

N°323,446

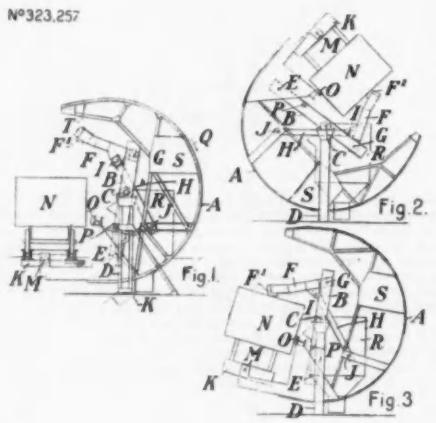


together of comparatively thin plates, although their gauge is not specified. In the process of closing the rivet the plates are deformed, as shown, by the pressure of the large head of the rivet, and a flush surface is thus formed.—*January 2nd*, 1930.

323,257. September 24th, 1928.—WAGON TIPPLERS, E. West and West's Gas Improvement Company, Ltd., Albion Ironworks, Miles Platting, Manchester.

The main frame A, which consists of end members connected by cross members or girders, is pivotally carried by the lower ends of arms B, one at each end of the frame. Such arms fulcrum about a fixed axis C upon columns D. The pivoting point of the frame upon the arms is shown at E. The ends of the arms B above the pivots C have the clamping arms F pivoted thereto at G. Each arm F has a link H connected thereto at I, such link being also connected to the frame A at J. The tipping platform K is pivotally mounted at M upon the frame A, the pivot being disposed in known manner to one side of the platform, so that the weight of the wagon N and platform always tends to turn the latter towards the frame, which has a buffer O thereon, against which the side of the wagon can bear. When the arms B are in the normal positions, as shown in Fig. 1, a stop piece P thereon rests against the column D. With the construction described, when the frame A is operated by ropes connected to its end T in a direction indicated by the arrow Q

N°323,257

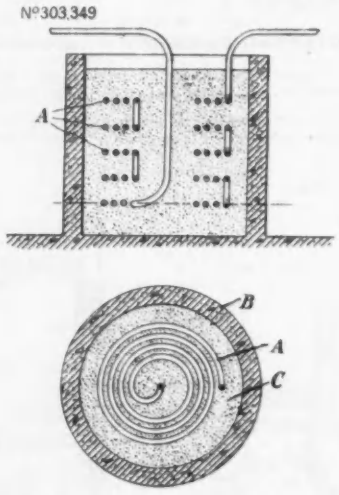


in Fig. 1 to tip the wagon N upon the tipping platform K, the first movement of the frame is a pivotal one about the pivots E at the lower ends of the suspension arms B. During such movement the tipping platform K is raised sufficiently from its support to allow it to turn the wagon against the side buffer O, and the clamping arms F with their clamping buffers F¹ are brought down on to the wagon. This position of the parts is shown in Fig. 3. Until, however, the motion of the clamps is arrested by engagement with the wagon, the suspension arms B remain with their stop pieces P against the columns D, owing to the weight of the wagon. When, however, the clamps engage the wagon, further movement of the frame A in the direction of the arrow Q causes the arms B carrying the frame to turn about the fixed fulcrum C, which gives the desired tipping motion to the wagon and brings it to the position shown in Fig. 2. In this position the distribution of the weights of the various parts of the apparatus is such that the reaction of the clamp F¹ exceeds the pressure put upon the clamp by the weight of the wagon. The return of the wagon is effected by reversing the driving gear, so as to allow the wagon to descend by gravity until the suspension arms B return with their stops P against the columns D, after which the clamps F are raised and the wagon and platform return to their original positions. R indicates the hopper or chute into which the contents of the wagon are tipped. The weight of the wagon can be counterbalanced to any desired extent by a ballast box S, to reduce the power required for tipping the same. The tipping gear is so arranged that the top clamps will engage any usual height of wagon before tipping commences.—*December 24th*, 1929.

303,349. November 1st, 1928.—ELECTRIC CURRENT LIMITING REACTORS, Condit Electrical Manufacturing Corporation, of 842, Summer-street, Boston, U.S.A.

The reactor described in this specification comprises a number of superposed layers of conductors A and the direction of the current flow in the conductors is such that the magnetic

N°303,349



effects of the turns in the various layers are additive. The reactor is contained within a cylindrical wall, which is open at the top. The conductors are embedded in sand, the main function of which is to support the conducting elements against displacement due to the magnetic forces. Preferably the sand is a dry quartz sand, reasonably free from metallic compounds.—*January 2nd*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-Ferrous Section of the Applied Science Department of the University, St. George's-square. "Recent Developments in Measuring Instruments," by Mr. S. Matthews. 7.30 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—At the Rooms of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Optical Aids to Engineering Inspection," by Professor A. F. C. Pollard. 5.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—In the Building of the Manchester Literary and Philosophical Society, 36, George-street, Manchester. "Water-tube Boilers Suitable for Locomotives," by Mr. K. W. Willans. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, Westminster, London, S.W. 1. Informal meeting. Lantern lecture, by Mr. G. Stevenson Taylor, followed by a visit to the Home Office Industrial Museum. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Informal meeting. Technical film, "The Manufacture of Staybrite and Stainless Steels," at the works of Thos. Firth and Sons, Ltd., with notes by Mr. J. G. Hoperaft, M.C. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—At the Temperance Institute, Room 14, Keighley. "Modern Gas Production," by Mr. F. Allen. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Annual dinner, Midland Hotel. 6.45 for 7.15 p.m.

PHYSICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "The Diffusion Constant of Water Vapour," by Mr. W. E. Summerhays; "A Method of Calculating the Numerical Equation of State for Helium below 6 deg. Abs., and of Estimating the Relative Importance of Gas Degeneracy and Interatomic Forces," by Mr. M. C. Johnson; "The Magnetostriction Constant for Alternating Magnetic Fields," by Mr. F. D. Smith. 5 p.m. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.

MONDAY, FEBRUARY 17TH.

BRADFORD ENGINEERING SOCIETY.—In the Hall of the Bradford Technical College, Bradford. "Preheated Air for Boiler Furnaces," by Mr. J. Taylor Fleming, illustrated by lantern slides. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Graduates' Section, London. "Strip Rolling Mills and Auxiliary Machinery," by Mr. W. W. S. Robertson. 7 p.m.

KING'S COLLEGE ENGINEERING SOCIETY.—Engineering Society's Room, King's College, London, W.C. 2. "Workshop Management," by Mr. L. Piyamedhi. 5.15 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lectures—"Recent Improvements in Methods of Brickmaking," by Mr. Alfred B. Searle. 8 p.m.

MONDAY TO FRIDAY, FEBRUARY 17TH TO 28TH.

BRITISH INDUSTRIES FAIR.—Olympia and Castle Bromwich, Birmingham.

TUESDAY, FEBRUARY 18TH.

ILLUMINATING ENGINEERING SOCIETY.—At the Lighting Service Bureau, 15, Savoy-street, Strand, W.C. 2. "Modern Incandescent Lighting in Kinema Studios," by Mr. W. H. Villiers, followed by a discussion. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND STUDENTS' SECTION.—Joint meeting with the Graduates' Section of the Institution of Mechanical Engineers, Yorkshire Branch, at the Hotel Metropole, Leeds. The subject for discussion, which will be opened by Mr. C. S. T. Paul, will be "Steam versus Electricity for the Drive of Auxiliaries in Power Plants." 7.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Cobalt Magnet Steels," by Mr. H. E. Kershaw. 7.30 p.m.

TUESDAY AND WEDNESDAY, FEBRUARY 18TH AND 19TH.

SOCIETY OF GLASS TECHNOLOGY.—Tuesday, 4.45 p.m., German Visit Committee, at Applied Science Department, University, Sheffield; 5.15 p.m., Glass Standards Committee, Applied Science Department, University, St. George's-square, Sheffield; 7 p.m., informal dinner of members of Council and their friends, at King's Head Hotel, Sheffield; 8.15 p.m., Council meeting. Wednesday, 8.45 a.m., visit to Silica Brick Works of Yorkshire Amalgamated Products, Ltd., near Bawtry; 12.45 p.m., luncheon, King's Head Hotel, Sheffield; 2 p.m., general meeting, Applied Science Department, University, St. George's-square, Sheffield, to discuss a selection from the following papers:—"The Ternary System K_2O—CaO—SiO_2," by Dr. G. W. Morey, Mr. F. C. Kracek and Mr. N. L. Bowen; "Note on the Determination of Boric Oxide in Glass," by Miss Violet Dimbleby; "The Thermal Expansion of Glasses of Three or More Constituents," by Professor W. E. S. Turner and Mr. F. Winks; "Notes on Various Old Glasshouses," by Mr. Francis Buckley; "A Study of the Chemical Reactions in the Melting of Potassium-Borosilicate Glass," by Mr. M. A. Besborodov and Mr. Z. M. Silberfarb.

WEDNESDAY, FEBRUARY 19TH.

INSTITUTION OF PRODUCTION ENGINEERS: BIRMINGHAM BRANCH.—Windsor Room, Grand Hotel, Colmore-row, Birmingham. "Recent Developments in Engineering Materials," by Mr. T. Henry Turner. 7 p.m.

NEWCOMEN SOCIETY.—At the Institute of Marine Engineers, Minories, E.C. 3. "Pioneer Ships of the Atlantic Ferry," by Eng.-Capt. E. C. Smith. 5.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—In the Lecture Hall of the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. "Gliding," by Dr. Georgii. 6.30 p.m.

ROYAL MICROSCOPICAL SOCIETY.—20, Hanover-square, London, W. 1. Meeting at 7.30 p.m.

THURSDAY, FEBRUARY 20TH.

KING'S COLLEGE ENGINEERING SOCIETY.—Engineering Society's Room, King's College, London, W.C. 2. "Notes in Consideration of Some Aeronautical Matters," by Mr. V. A. R. French. 5.15 p.m.

FRIDAY, FEBRUARY 21ST.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Prince's Chambers, 16, Corporation-street, Birmingham. A visit to the British Industries Fair, Birmingham.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London. Annual general meeting. The annual report of the Council will be presented. Annual election of Council. Report to be discussed, Sixth Report of the Steam Nozzles Research Committee. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Ordinary meeting. "The Application of Electric Welding to the Erection and Strengthening of Steel Structures," by Mr. E. P. S. Gardner. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Powdered Coal for Ship Propulsion," by Admiral W. Scott Hill. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. Discourse, "Principles of Plant Breeding," by Mr. J. B. S. Haldane. 9 p.m.

MONDAY, FEBRUARY 24TH.

KING'S COLLEGE ENGINEERING SOCIETY.—Engineering Society's Room, King's College, London, W.C. 2. "Railway Permanent Way," by Mr. B. E. Willett. 5.15 p.m.

WEDNESDAY, FEBRUARY 26TH.

ENGINEERING GOLFING SOCIETY.—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual general meeting. 12.30 p.m.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION AND FARADAY HOUSE RUGBY CLUB.—Supper dance at the Hotel Russell, Russell-square, W.C. 1, from 8 to 2.

INSTITUTION OF CHEMICAL ENGINEERS.—At Burlington House, Piccadilly, London, W. 1. "The Formation and Growth of Crystals," by Professor W. E. Gibbs. 8 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the works of Barrow, Hepburn and Gale, Ltd. 2.30 p.m.

THURSDAY, FEBRUARY 27TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Creep of Metals at High Temperatures," by Mr. R. W. Bailey. 7 p.m.

KING'S COLLEGE ENGINEERING SOCIETY.—Engineering Society's Room, King's College, London, W.C. 2. "Modern Practice in the Manufacture of Portland Cement," by Mr. B. C. Mathiesen. 5.15 p.m.

FRIDAY, FEBRUARY 28TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "The Design of Electrical Machinery," by Mr. J. Rowcroft. 7.30 p.m.

MONDAY, MARCH 3RD.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Graduates' Section, London. Annual meeting. Informal discussion on "Workshop Practice at Home and Abroad." 7 p.m.

FRIDAY, MARCH 7TH.

INSTITUTE OF MARINE ENGINEERS.—Connaught Rooms, Great Queen-street, London, W.C. Annual dinner. 7 for 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Extra general meeting. "The Strength and Design of Fusion Welds for Unfired Pressure Vessels," by Mr. L. W. Schuster. 6 p.m.

SATURDAY, MARCH 29TH.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—Trocadero Restaurant, London. Annual dinner.